

November 1997

# Mobile Radio Technology<sup>®</sup>

Technical information for paging, SMR and private wireless networks.

## Maintenance for CDMA Base Stations



Coordinating Police Radio  
Reducing Costs with DSP  
Integrated Networks  
Web Site Directory



# QuickCheck

The **Xplorer** Test Receiver. The professional choice when speed, performance, and reliability are an issue !

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Patent No. 5,471,408

## FEATURES

- Nearfield receiver, sweeps **30MHz-2GHz** in <1 second
- Decodes **CTCSS**, **DCS**, and **DTMF**. Manually record tones into memory
- Lockout up to 1000 frequencies
- Store **500 frequencies** in **memory** with time & date stamp, as well as number of hits per frequency
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- **Auto** or manual frequency **hold**
- **Maximum nearfield** reception / Up to **1/4 mile** away



MADE IN U.S.A.

Xplorer includes: TA100S antenna, NiCads, Charger, PC Download cable and software

## SPECIFICATIONS

Freq. Range	30MHz - 2GHz
Modulation	FM Deviation
Freq. Response	50 - 3000Hz
Auto Sweep Time	<1 second
Input 50 Ohm	-59dBm @100MHz -25dBm @1GHz
Display	2 line LCD
Power	Internal NiCad



CTCSS Decode



DCS Decode



DTMF Decode

**CTCSS, DCS, and DTMF Decoding**

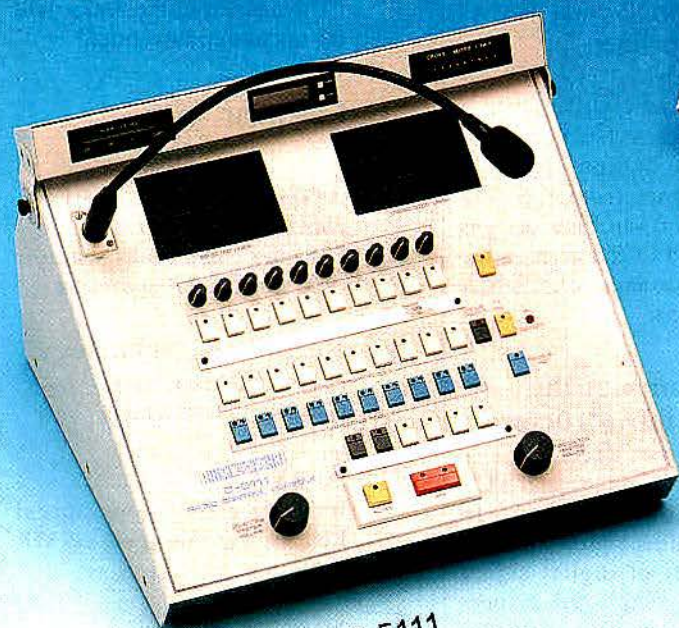
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Model C-5112



Model C-5110B

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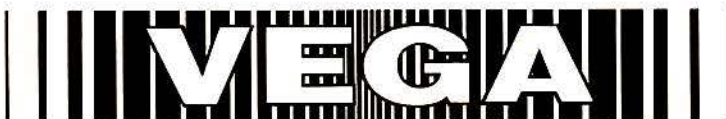
Standard features available on the cost-effective and versatile 5100 Series consoles include:

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- ☐ **RX ALL switch** for monitoring all unselected lines
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- ☐ **GROUP SELECT switch** for easy selection of TX / RX line combinations
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## OPTIONS

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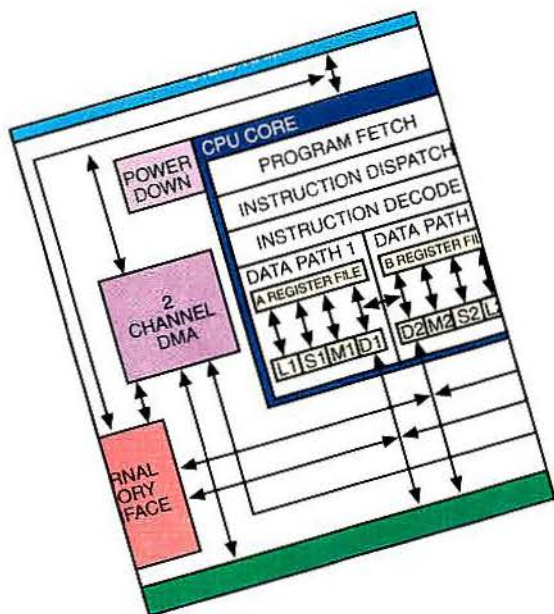
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**On the cover:** Portable test sets have been designed specifically for technicians who maintain many CDMA base stations in all kinds of weather. See story, page 10. Photo courtesy of Hewlett-Packard, Liberty Lake, WA.

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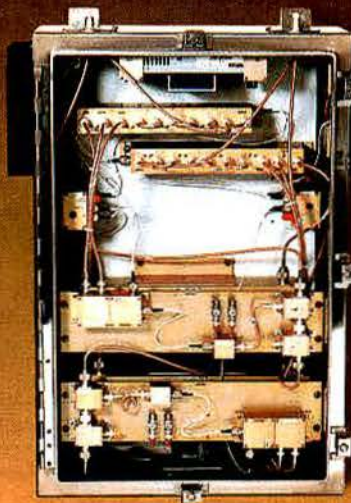
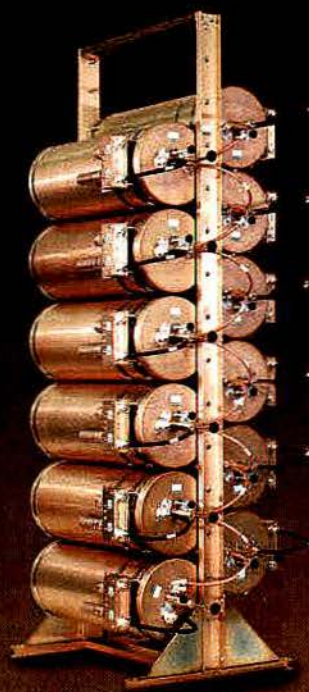
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## 'The amount of the notice will be uncomfortably brief.'



About five years ago, the FCC froze license applications for new exclusive private radio systems in the 470MHz-512MHz band to give it time to "refarm" the spectrum. Refarming is a change of technical, operating and licensing requirements intended to fit more users into a given portion of spectrum.

In 1995, the FCC issued new rules in the refarming proceeding and announced that it would lift the freeze.

Shortly thereafter, it delayed lifting the freeze when the Land Mobile Communications Council (LMCC) asked for time to recommend procedures for coordinating applications and for avoiding interference among the new and existing systems. LMCC wanted to avoid the prospect of conflicting applications being filed with different coordinators and then being forwarded to the FCC. The FCC might use auctions to resolve mutually exclusive applications, something most private radio users want to avoid.

On Sept. 10, 1997, LMCC sent its plan to the commission. In response, the FCC announced that it would lift the freeze on Oct. 17. Since Oct. 1, license seekers have been permitted to submit applications to frequency coordinators, and the coordinators now communicate with each other about conflicting applications. Regardless of which coordinator receives an application to use a given frequency in a given location, the first such application received is the one to be forwarded to the commission.

Then, on Oct. 7, in a move that surprised an audience to whom he spoke at the Industrial Telecommunications Association conference in Washington, an FCC official announced that the freeze may not be lifted after all.

The reason seems to be a combination of factors.

For one thing, several petitions for reconsideration sent to the FCC in the refarming matter haven't yet been answered. Maybe, all by itself, the question of these petitions wouldn't have led to a continuation of the freeze. But there is some concern that one or more of the petitions might be resolved in a way that would require the FCC to modify or rescind some of the licenses granted after Oct. 17.

For another thing, the Association of Public-Safety Communications Officials—International (APCO), which represents police and fire departments, filed an "emergency petition for clarification" with the FCC on Oct. 1, pointing out a possible problem: Business and industrial users might apply for licenses to use full-power radio systems on channels separated as little as 12.5kHz from existing public safety systems. Too close, says APCO. And APCO thinks the FCC hasn't made it clear whether such assignments would be allowed.

Although careful frequency coordination *might* and *should* avoid interference from the 12.5kHz offset channels, APCO wants to be sure. It wants offset channels adjacent to existing public safety systems to be reserved for future public safety applicants only.

Complicating things even more, the 1997 federal Balanced Budget Act contains two definitions of "public safety services." One falls in line with APCO's traditional "guns and hoses" membership of police and fire agencies. This definition is in language that describes entities intended to receive real-located spectrum from TV channels 60-69. The other, a broader definition, includes utilities, railroads, pipelines, automobile clubs and metropolitan transit authorities. It appears in language that describes radio services not subject to spectrum auctions, and that directs the FCC to make sure that, when allocating spectrum, it takes into consideration the needs of this broader class of public safety users.

So, previously filed petitions for reconsideration, the APCO petition and the potential for several additional classes of radio users to claim certain rights or privileges as "public safety" users led the chief of the FCC Wireless Telecommunications Bureau, Daniel Phythyon, to make an announcement Oct. 7 at the ITA conference. He said it was his intention to stay the order lifting portions or all of the freeze on

accepting applications for exclusive systems in the 470MHz-512MHz band. With the freeze otherwise having been due to lift only 10 days later, he commented, "The amount of the notice will be uncomfortably brief."

The freeze already has been "uncomfortably long."

Phythyon said he has no estimate of a new timeline for resolving the issues underlying the freeze. As of Oct. 9, with this column due to be sent to the printer, it looked as though Phythyon might lack enough commissioners' votes to sustain the stay he said he intended to issue. So as you read this, the controversial stay may not have been issued, and there may be joy in private radio. If the stay *is* issued, a lot of private radio users, equipment dealers and manufacturers will be justifiably frustrated, and you might hear them yell from where you are.

Let there be joy.

\* \* \*

### Moratoria no more

On Sept. 11, adding its voice to that of Cellular Telecommunications Industry Association (CTIA), Personal Communications Industry Association (PCIA) called on the FCC "to preempt state and local moratoria on tower siting that bar entry into the wireless communications marketplace." PCIA wants an end to open-ended moratoria, any single moratoria or cumulative moratoria extending beyond 90 days and any moratoria based on radio-frequency emission concerns.

The FCC has shown reluctance to preempt state authority in certain matters, partly because federal courts sometimes scrutinize preemptions carefully and may overturn them. Once upon a time, though, the FCC was reluctant to regulate the frequency coverage of radio receivers, and it managed to reform its ways on that matter at the histrionic urging of CTIA. Maybe CTIA and PCIA together can cause the FCC to reform its ways once again and override state and local government authority. Maybe. Scanner hobbyists don't have access to taxpayer money to pay for the defense of their interests. State and local governments do.

That's what you want to see, isn't it? Your state and local tax dollars being used to pay lawyers to fight other lawyers paid by your federal tax dollars in a court supported by—your tax dollars.

—Don Bishop



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SS-25	20	25	2 7/8 x 7 x 9 3/8	4.2
SS-30	25	30	3 3/4 x 7 x 9 5/8	5
SS-25M*	20	25	2 7/8 x 7 x 9 3/8	4.2
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## 1997

### October

27-29—**Wireless Apps**, sponsored by the Cellular Telecommunications Industry Association, Seattle Convention Center, Seattle. Contact: Francesca Dea, 702-739-4025, or Tim Ayers, 202-736-3203.

27-28—**Small Business in Telecommunications Legislative Forum**, Sheraton Washington, Washington, DC. Contact: 202-736-3203.

### November

6-7—**AMTEX**, sponsored by the American Mobile Telecommunications Association, Hilton at Walt Disney World Village, Orlando, FL. Contact: 202-331-7773.

6-8—**Second International Congress on Commercial Trunked Radio**, sponsored by the International Mobile Telecommunications Association, Hilton at Walt Disney World Village, Orlando, FL. Contact: 202-331-7773.

12-16—**Communications Marketing Conference**, sponsored by the Communications Marketing Association, Holiday Inn International Drive Resort, Orlando, FL. Contact: Bernie Brownson, 303-371-8182.

21—**Radio Club of America**, Communications Symposium, 88th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.

## 1998

### February

23-25—**Wireless**, sponsored by the Cellular Telecommunications Industry Association, Georgia World Congress Center, Atlanta. Contact: 212-964-7000.

### March

1-4—**ENTELEC**, sponsored by the Energy Telecommunications and Electrical Association, Marriott River Center, San Antonio, TX. Contact: 281-357-8700.

## April

20-23—**Expo Comm/Comdex**, sponsored by E.J. Krause & Associates, McCormick Place, Chicago. Contact: 301-493-5500.

22-24—**International Wireless Communications Expo**, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

## May

18-21—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Westin Hotel, Ottawa, Canada. Contact: 908-562-3870.

20-22—**Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto, Canada. Contact: 613-233-4888, ext. 102.

## June

8-11—**Supercomm**, sponsored by USTA and TIA, Georgia World Congress Center, Atlanta. Contact: 202-326-7300.

28-July 2—**UTC National Conference & Exhibition**, sponsored by UTC, The Telecommunications Association, Hynes Convention Center, Boston. Contact: 202-872-0030.

## September

23-25—**Personal Communications Showcase**, sponsored by Personal Communications Industry Association, Orange County Convention Center, Orlando, FL. Contact: 703-739-0300.

23-25—**PCS Latin America**, sponsored by the Personal Communications Industry Association, Orlando, FL. Contact: Cathy Graham, 703-739-0300, ext. 3706.

## October

14-16—**TelecomLatina**, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 1-800-288-8606.

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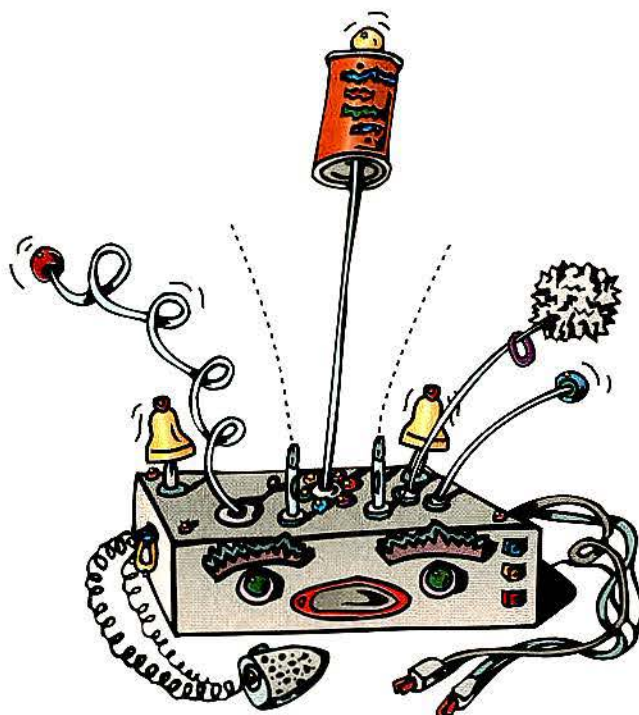
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## Locating cable faults with the time domain reflectometer

By Harold Kinley, C.E.T.

Opens, shorts or less-severe impedance discontinuities have a way of showing up on cables in strange places—places you might never suspect. These can occur on coaxial transmission lines or twisted-pair lines. Such opens, shorts or other impedance discontinuities are called *faults*. The location of faults cannot be determined with simple ohmmeters. Even the existence of certain faults cannot be determined with an ohmmeter. After all, we can't begin to correct a fault unless we know where it is or at least have some

idea where to start looking for it.

### Time domain reflectometer

The basic principle of the time domain reflectometer (TDR) is fairly simple. See Figure 1 below. A pulse is generated and sent down the line. If the line is terminated in a load impedance that is equal to the characteristic impedance of the line ( $Z_0 = Z_L$ ), no reflected wave or echo will be returning to the generator or source. Let  $P_i$  represent the incident pulse generated by the pulse generator and  $P_r$  represent the echo or pulse reflected by the impedance discontinuity. By measuring the time difference between the incident

pulse ( $P_i$ ) and the echo or reflected pulse ( $P_r$ ), it is possible to determine the distance to the fault that produced the echo pulse. Calculations must include the velocity factor of the cable.

If a transmission cable has a velocity factor of 1.0, then a pulse will propagate down the line at 0.982 foot per nanosecond (0.982ft/ns). If the velocity factor of a transmission cable is 0.66 and the time difference between  $P_i$  and  $P_r$  is 430ns as measured on the time base of the oscilloscope, then the distance traveled by the echo pulse is:  $0.66 \times 0.982 \times 430 = 278.69$ . Thus the echo pulse has traveled 278.69 feet in 430ns. To get the distance from the source to the fault, we must divide this figure (278.69) by 2 to get 139.35 feet, the distance that the echo must travel back up the line to reach the point of measurement on the scope. The general formula for this equation is:

$$D = \frac{0.982VT}{2}$$

where

$D$  = distance to fault in feet

$V$  = velocity factor

$T$  = time between pulses in nanoseconds.

### Cablemate Analyst reflectometer

The Cablemate Analyst reflectometer from Advanced Electronic Applications (a division of Tempo Research, Vista, CA) is a low-priced, feature-packed TDR in a small, hand-held unit. All of the features of this unit cannot be described in this space; however, some of the more essential features will be presented. Although it is not necessary, in most cases, to use an oscilloscope with this instrument, the manufacturer has made it convenient to do so. The use of an oscilloscope makes it possible to see minor reflections that might not be picked up by the instrument.

### Using the oscilloscope

The oscilloscope is connected to the reflectometer exactly as shown in Figure 1.

(continued on page 38)

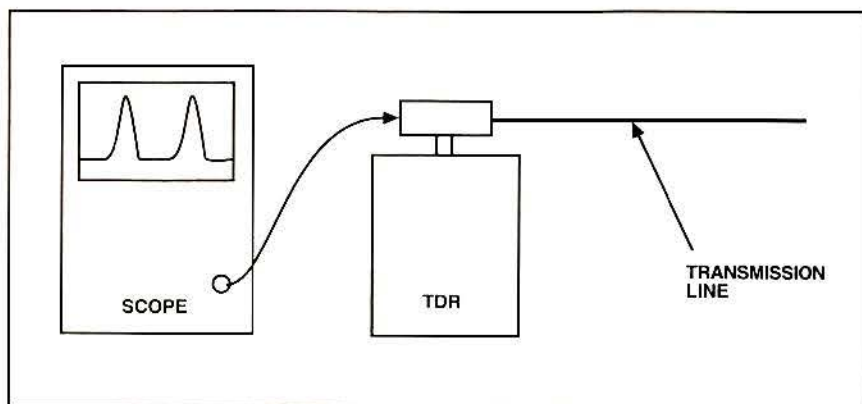


Figure 1. To closely examine the echo pulse(s), an oscilloscope is connected to the TDR. By measuring the time delay between the incident and echo pulses, the distance to the fault can be determined. The Cablemate Analyst reflectometer makes it simple to perform this calculation.

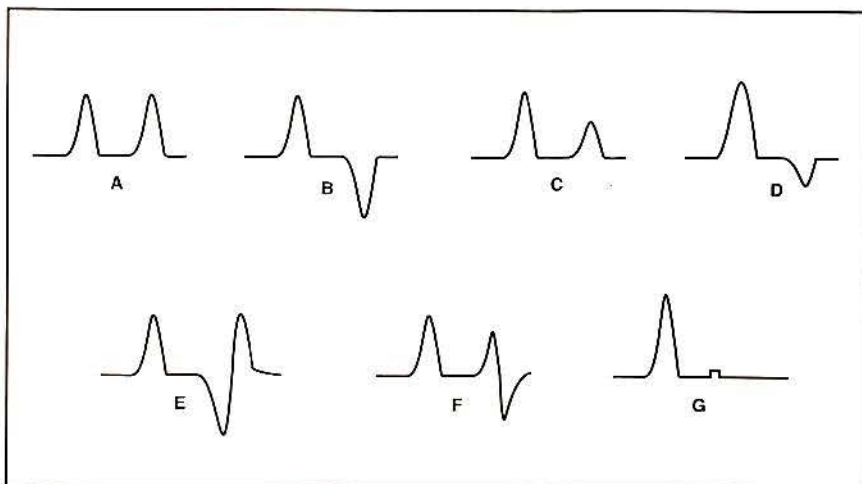
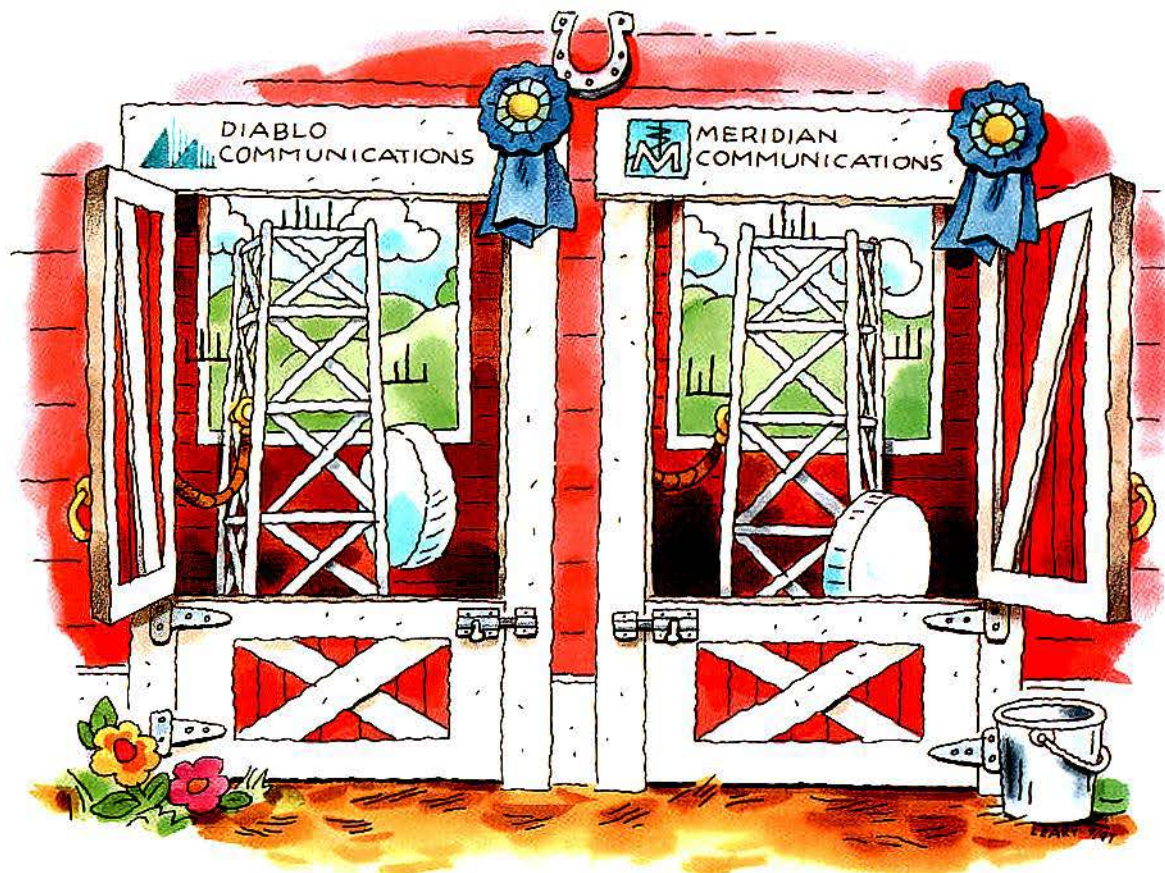


Figure 2. Waveforms for various load impedances. At A, the transmission line is open, resulting in a positive echo pulse nearly equal to the incident pulse. At B, the transmission line is shorted, resulting in a negative echo pulse nearly equal to the incident pulse. At C, the transmission line is terminated in a load impedance much higher than the characteristic impedance of the line. At D, the transmission line is terminated in a load impedance much less than the characteristic impedance of the line. At E, the transmission line is terminated in a capacitive reactance. At F, the transmission line is terminated in an inductive reactance. At G, the transmission line is terminated in a load impedance slightly greater than the characteristic impedance of the line, resulting in a minor reflection.

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyld Drive, Spartanburg, SC 29301. Kinley's email address is [hkinley@aol.com](mailto:hkinley@aol.com).





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# PCS base station maintenance calls for a fresh approach

*PCS networks will create a workload for technicians of 20 to 40 base stations each, in environments ranging from freezing cold to desert sun. New designs in equipment are required to characterize the RF performance of CDMA base stations.*

By Bob Garner, B.S.E.E.

Personal communications services (PCS) may be the "next big thing" in wireless communications, but the PCS infrastructure is throwing service providers and their technicians a curve. Compared to their cellular predecessors, PCS base stations are far less accommodating

Garner is product manager at Hewlett-Packard's Spokane Division, Liberty Lake, WA.

places to make measurements. Unlike the comparatively comfortable cellular equipment "bunkers," there is often no enclosure to shelter the PCS technician and test equipment from the elements. Instead, the technician may have to work on a concrete slab or rooftop, fully exposed to sun, rain, snow and driving wind.

Next, there are new measurements to make, given the predominance of code-division multiple-access (CDMA) as the PCS access method. CDMA signals are wholly different from analog signals, such as FM, and significantly different even

from those of other digital communication methods such as time-division multiple-access (TDMA). Traditional analog measurements of transmit power and receiver sensitivity are inapplicable to spread-spectrum modulation techniques. Not only are new measurements required, but new instruments are needed to make them.

Finally, there are simply more sites to maintain in PCS networks because the low transmit power of PCS requires more base stations than higher-power cellular systems require to serve the same geographic area. For technicians, this means

## Designing equipment for the PCS field testing environment

Hewlett-Packard realized that traditional field testing instruments whose capabilities were stretched to include PCS situations would at the best create an unpleasant test environment for the technician, and at worst make maintenance difficult or impossible to perform. As a result, a decision was made to make the HP 8935 test set as different as it needed to be to satisfy the needs of technicians who must maintain PCS base stations in conditions ranging from freezing cold to bright sunlight and desert heat.

Some of the unique operational features of this design effort include:

- The test set is the size of an overnight bag and weighs 44 pounds. Because no additional instruments are needed to characterize the RF performance of the base station, this represents the total weight of RF test instrumentation that the technician must bring to the site.

- All connections are made on a recessed interface panel located on the side of the instrument. This allows it to be operated in an upright position, a



Photo 1. The HP 8935 was designed specifically for PCS CDMA base station testing.

frequent necessity because convenient waist-high tables or shelves are rarely present. The configuration also reduces the space needed and keeps cables from covering the display and keypad.

- When placed in its operating position, the bottom of the test set is protected by an ABS plastic shield that raises the body of the instrument and provides a space for airflow while protecting the unit from dirt, mud, snow and other contaminants. Air flow through the unit is kept free of contami-

nants by a removable filter.

- Although the instrument is not waterproof, it is designed so that dirt and moisture cannot enter the keypad, which can be wiped clean with a damp cloth. The display is also gasketed to resist the entrance of moisture. When in its operating position, the majority of the test set's weight is present in the portion closest to the ground, making it difficult to tip over.

- Because LCDs are not well-suited to operation in even moderate sunlight, or over wide temperature ranges, HP selected electroluminescent technology, which is visible even in the brightest direct sunlight and performs well over any temperature range likely to be encountered by a service technician.

- Finally, the test set was designed to withstand abuse in field operation. It was subjected to tests similar to those required of military test equipment, and it can withstand high levels of shock and vibration.

—Bob Garner

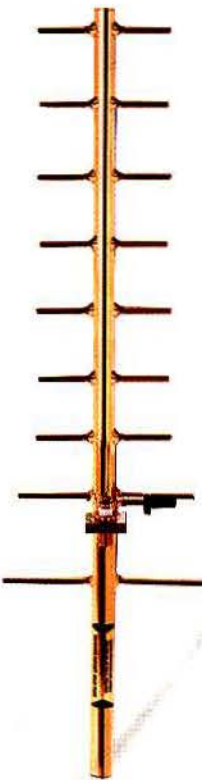


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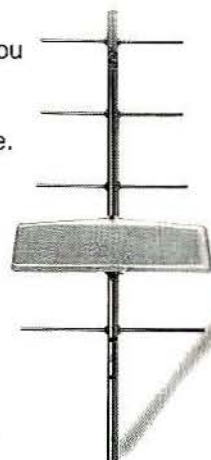


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a heavier load of site assignments and a reciprocal decrease in the time available to make measurements at each site.

Taken together, these requirements have created the need for portable test sets that vary in many ways from the test systems designed to evaluate the performance of cellular systems.

#### From whence we came

Early PCS test systems were either

communications test sets sporting PCS "top boxes," or they were "portable" RF measurement systems that consisted of several instruments connected by coaxial cables. While less than streamlined in their setup and operation, they nevertheless served the urgent need of base station manufacturers and service providers for field test equipment. After all, CDMA-based communications systems had never been deployed before, much less tested, in

commercial service, so the time frame in which test solutions were created by test equipment manufacturers was rather short.

However, now that PCS systems are more mature, and carriers have gained operation and maintenance experience, service providers are calling for a new standard of test equipment. Considerations are not just the measurements, but also the speed and ease with which these measurements can be performed, and the reliability and suitability of the test set for PCS environments in which technicians must operate.

To learn more about these requirements, our field application engineers spent many hours with PCS engineers and technicians who worked for base station manufacturers and service providers. The information gleaned from these experiences in the field led to the development of the HP 8935 CDMA PCS test set (see sidebar on p.10) to satisfy the unique requirements of the PCS base station maintenance environment.

#### Base station maintenance wish list

In general, technicians said they wanted a single instrument that could perform all of the tests required to ensure that a CDMA PCS base station was properly operating. They did not want to carry around several instruments and cables, and they did not want to perform tedious set-up at each site. Automation of instrument functions and test routines was a frequent request.

Perhaps most important was the technicians' common desire to have an instrument that they did not have to treat with "kid gloves," like the many instruments that were originally designed for the cozy bench-top environment and were pressed into service as "field test equipment" by virtue of handles bolted to their front panels. Field equipment needs to be reasonably weather-resistant and rugged, and it should have a display that is readable in direct sunlight. Cable interfaces that might obscure the display should not be on the front panel cables.

Service provider managers were consistent in their requests for an instrument that was extremely easy to use, so that people with a minimum level of technical knowledge and experience could confidently make measurements in the field. Finally, with an average load of 20 to 40 base stations per technician, the time required to verify base station performance had to be as short as possible.

While the wish lists from both groups were formidable, implementation of their requests was at least simplified by their similarities. Technicians and managers



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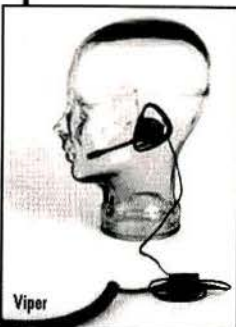
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were seeking the same types of instruments, but for different reasons.

Technicians said they needed automation, ruggedness, and a "single-box" design to make their measurement "quota." Managers said they needed simple, rugged, highly automated instruments that were simple to use, so that training time and costs could be reduced. They wanted instruments that could withstand heavy-duty service for long periods, with accurate measurement procedures that would be repeatable from base station to base station.

Similarities aside, creating an instrument to accommodate these needs required a completely new design because the test set would have to possess features and characteristics that had never before been assembled into a single instrument.

#### Requests become reality

The instrument that emerged from the design process is traditional only in the sense that it performs RF measurements. The test set contains all of the hardware and software required to maintain the RF portion of a PCS CDMA base station. It also performs cable fault detection to identify transmission line problems right at the transmitter.

Unlike other PCS base station test sets, the test set eliminates the cable interfaces from the front panel where they can obscure visibility of the display. The interface panel is on the side of the instrument, which allows measurements to be made while the test set is facing upward. Because of the lack of open work space at most sites, "display-up" is likely to be the position in which the instrument will frequently be used. The test set is isolated from the ground by a protective shield that allows filtered air to enter, but nothing else.

The test set is also fully automated on two levels. Instrument-level automation allows test routines to run and measurement data to be taken and stored without operator attention. Manufacturer-specific automation performs test routines dedicated to specific base stations from manufacturers such as Lucent Technologies, Nortel and Samsung.

The test set will characterize CDMA signals for waveform quality (rho, p), average power, channel power, frequency error, carrier feedthrough, error vector magnitude, code domain power, code domain timing and code domain phase. It also measures VSWR, AM, FM, and

single sideband (SSB) emissions, audio quality, signal plus noise and distortion (SINAD), spectral purity (harmonic and spurious levels), frequency accuracy and interference.

#### Emphasis on hands-off operation

Although the ability to make these measurements in a single instrument is important, the way in which the measurements are made is equally important. Software within the test set allows measurements to be run with little or no operator intervention and offers the technician on-line help to ensure that measurement conditions are correct.

More important, the test set has the ability to control operation of Lucent and Samsung base stations, configuring itself automatically for the conditions of each test. The instrument controller and computer that orchestrate operation of the test set, combined with software developed by Hewlett-Packard, reduce measurement time to a fraction of what would be required if each measurement were performed manually, even if all of the capabilities to perform the measurements were contained in a single instrument.

The measurement process is further streamlined by the use of standard PCMCIA cards. The PCMCIA interface makes it possible to store and retrieve measurement data and IBASIC program parameters, and to input calibration data and upgrade instrument firmware from the front panel. Firmware upgrades performed in this way take only two minutes.

Although the tests performed on PCS base stations vary little from manufacturer to manufacturer, the ways in which the base stations of each manufacturer must be configured and controlled are unique. To overcome this obstacle, we added (in addition to internal automation capabilities) the ability to run software that tailors the test configuration and test routines to those required by base stations from specific manufacturers.

The manufacturer-specific software reduces the level of technical and manufacturer-specific knowledge required by the technician to make accurate and complete measurements, reduces measurement error and reduces the time required to make a complete set of measurements.

#### Conclusion

The sheer number of base stations required by PCS networks dictate the creation of techniques and instruments that save time, reduce maintenance costs, and ensure that customers experience good performance.



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# DSP permeates the wireless infrastructure

*The size of cellular and PCS base stations continues to shrink in direct proportion to the amount of digital signal processing (DSP) employed to perform the functions traditionally handled by analog components.*

By Artis C. Street, M.S.E.E.

The "bunker" has been a permanent fixture at base stations and cell sites of most types of wireless communications service, from SMR to paging and cellular. The familiar tower and equipment shelter contain all of the wireless infrastructure components, from baseband to switching, RF receive and transmit subsystems, transmission lines and antennas. While hardly lavish, the equipment shelter affords the

service technician a place to set up shop, and a well-controlled environment in which to operate electronic systems. Now, all of this is changing.

The feverish pace of wireless network build-outs and intense competition between cellular, personal communications services (PCS) and enhanced specialized mobile radio (ESMR) has produced a common goal: to develop, implement, maintain and upgrade base station equipment at the least possible cost. Inherent in this mission are the following wireless infrastructure design goals:

- Reduce base station size.
- Reduce the number of components required to achieve functionality.
- Make the station upgradeable in

place by means of software.

- Reduce station power consumption.
- Ease the nightmare of siting a base station by making its physical appearance more palatable to the community.

The architecture of PCS simplifies this task considerably; these networks transmit at much lower RF power levels than their large-cell cellular counterparts. This eliminates the need for high-power RF components that consume large amounts of dc input power and inherently reduces the size of the base station. Unfortunately, PCS networks require more base stations to serve a prescribed geographic area, which increases overall network cost.

Consequently, base station manufacturers are looking for all possible ways to reduce

Street is wireless infrastructure marketing manager for the Wireless Communications Business Unit of Texas Instruments, Dallas.

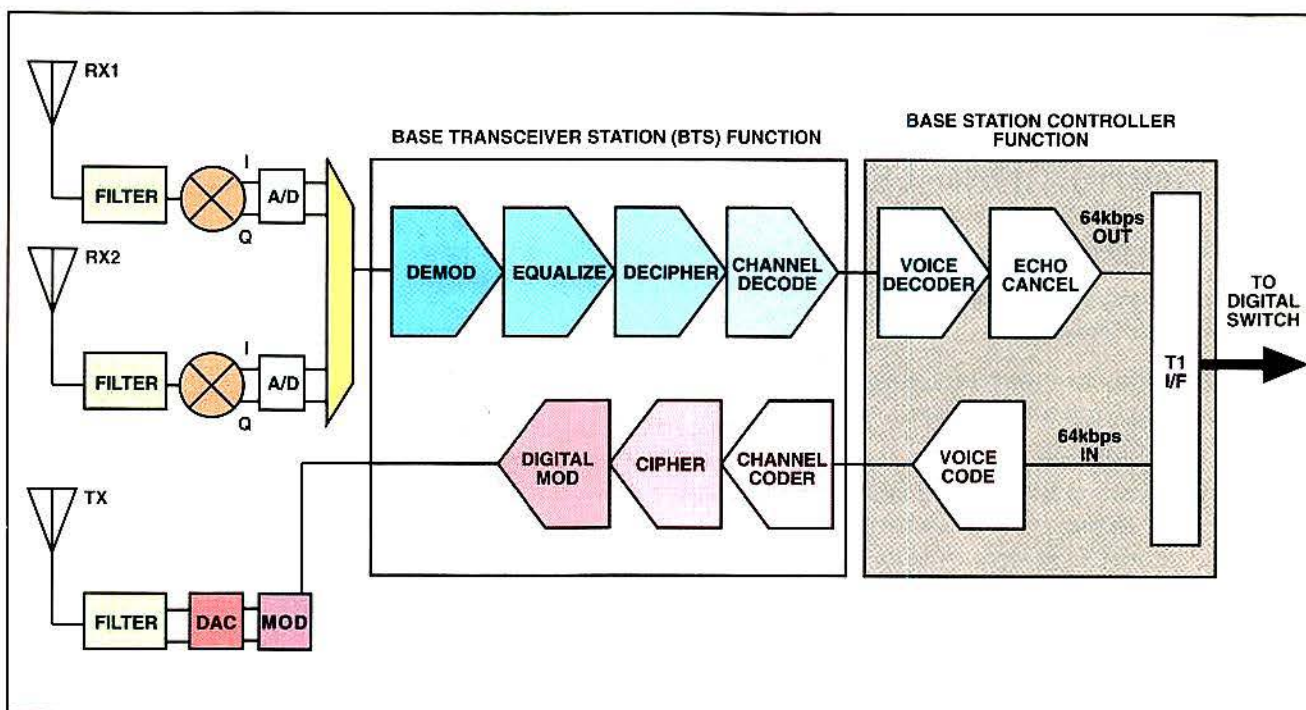


Figure 1. Key tasks are performed by DSPs (in this case TI's TMS320C6x family) in advanced wireless base stations for multiple channels.



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Table 1—Digital wireless communications summary

Air Interface or system standard	Access method	Data transmission rate (Kbps)
Global System for Mobile Communications (GSM)	TDMA	270.8
North American AMPS	TDMA	48.6
IS-95	CDMA	1288.0
IS-136 PCS	TDMA	48.6
Japan Digital Cellular (PDC)	TDMA	42.0

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costs—right down to the component level. In this task, they are aided immeasurably by digital signal processing (DSP).

## What was once analog...

By performing signal processing functions in the digital domain, DSP has the ability to affect all of the aforementioned wireless infrastructure subsystem design goals. Not surprisingly, DSP is replacing some analog components, and it is driving base station cost to levels more than an order of magnitude below those of their least expensive cellular counterparts as shown in Figure 1 on page 16.

It is essential to remember that once a signal has been converted to the digital domain, an entire new world of opportunity emerges to manipulate it. Large numbers of analog components are no longer needed because a few DSP-integrated circuits (ICs) and related components can perform all of those analog functions for less money, with less power consumption, in a fraction of the size and weight.

Technicians can remotely command DSPs to modify their functions and implement new functions via software, without replacing a single component. For service providers, this means fewer trips to the field by their growing armies of technicians.

## DSP design flexibility

Only in the past five years has DSP technology progressed to the level needed to perform some of the most demanding base station functions, such as speech encryption and orchestration of complex higher-order modulation techniques. Previously, the application-specific integrated circuit (ASIC) was the obvious choice because it could be designed to perform many functions within a single chip, and it could be tailored to meet the needs of specific applications and even specific products.

For this reason, the ASIC has become the basis of many electronic products. However, the ASIC is not a programmable device. Changing functions requires redesigning the ASIC and retrofitting it within platforms in the field. Even under the best circumstances, this requires months of design and prototype effort and at least one pass through the foundry.

Consequently, the ASIC design alone may not give designers the flexibility needed for future applications in the wireless infrastructure system. Nevertheless, the first code-division multiple-access (CDMA) PCS base stations to be installed (most of them in 1997) rely on ASICs because of the complex air interface and high data rate specified in the IS-95 standard. However, the rapid progress of DSP



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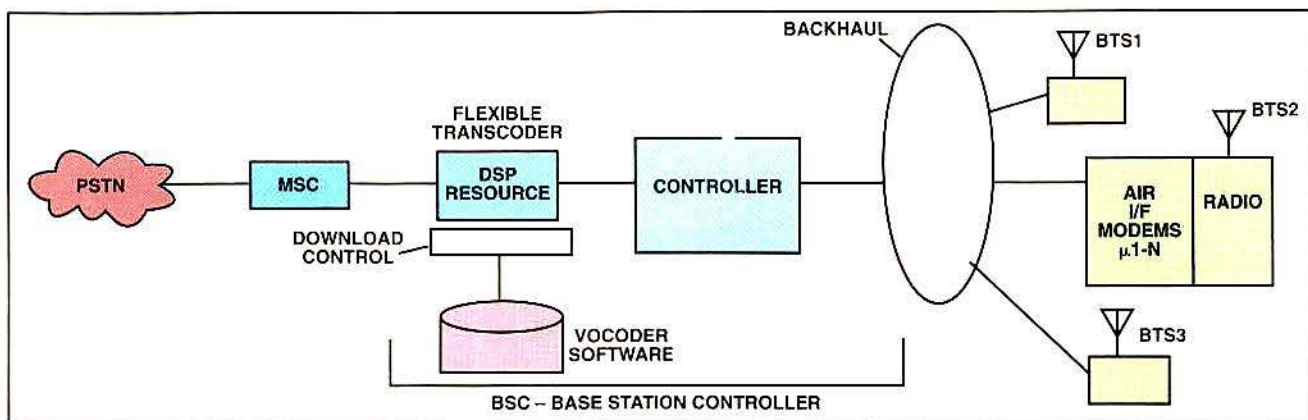


Figure 2. The DSP-based transcoder and its place in the digital wireless infrastructure.

technology should make it applicable for CDMA sometime in 1998.

### The digital wireless environment

The air interface standards with which base station manufacturers must comply rely on one of two access methods and their variants. The first is time-division multiple-access (TDMA), and the second is CDMA. Each method relies on a higher-order modulation scheme and a protocol that are the medium and format

by which information is communicated.

Each of these standards has different specifications. Their data rates vary considerably—a fact that directly affects the ability of DSP to handle their signal processing functions. For example, the IS-54 (TDMA) standard specifies a data rate of 48.6kbps, while GSM (a TDMA variant) has a much higher 270.8kbps rate. CDMA transmits data at a lofty 1.288Mbps, as shown in Table 1 on page 18.

As a result, DSP solutions for wireless

infrastructure applications have begun with lower-data-rate TDMA applications and are progressing through development of demodulator and equalizer subsystems for GSM. As noted, CDMA DSP will soon be available.

### The vocoder example

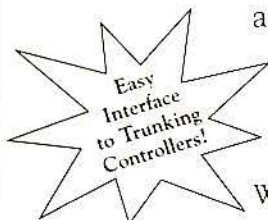
DSP-based solutions were first realized in wireless base stations within the base station controller. Early circuits were basic and required one processor per channel

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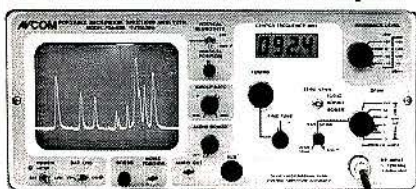
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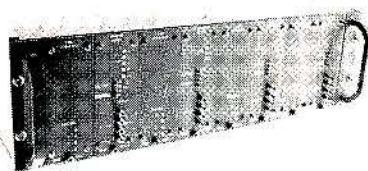
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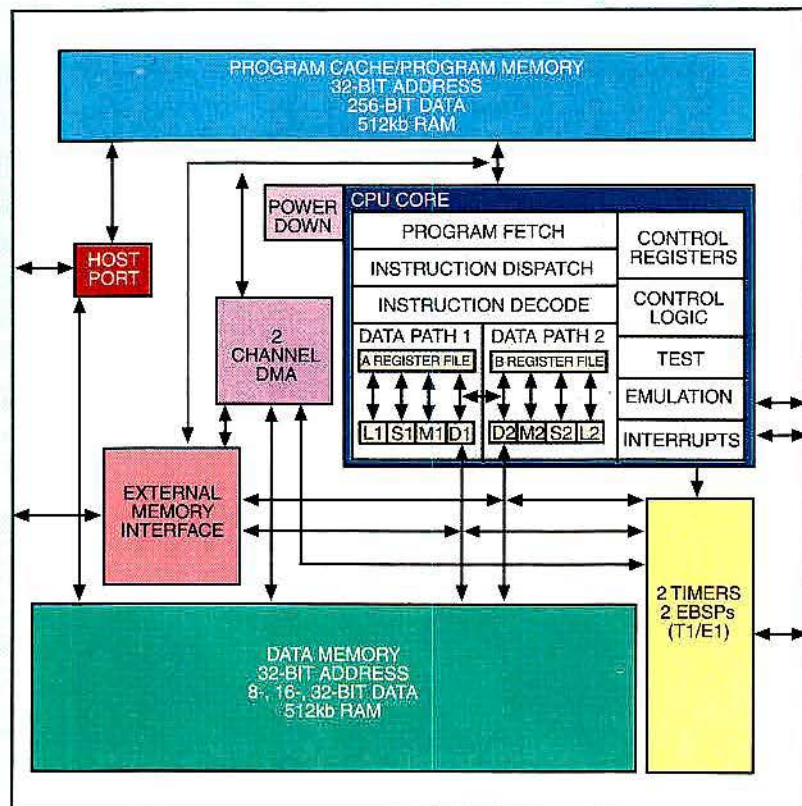


Figure 3. The TMS320C6201 architecture is surprisingly simple yet delivers processing power of 1600MIPS at 200MHz, 10 times the performance of previous DSPs.

## A DSP for wireless infrastructure

A growing number of DSP ICs are emerging to serve the demands of wireless infrastructure. Base stations require DSPs to have a high level of functional integration, large amounts of on-board memory, low power consumption, a wide array of I/O such as buffered serial ports, and a comprehensive set of development tools. Texas Instruments' TMS320C6x series of DSPs is an example of how DSP can be tailored for base station requirements.

The TMS320C6x design is based on the company's very long instruction word (VLIW) architecture, which increases the parallel execution of instructions by packing as many as eight 32-bit instructions into a single cycle.

The advanced C language compiler generates code that executes on highly independent functional units with triple the efficiency of previous fixed-point DSP compilers. The architecture is scalable to allow future enhancements.

This development path allows customized, programmable solutions to be created for applications such as CDMA base stations, which were previously the exclusive domain of ASICs. Using the TMS320C6201 architecture, it is possible to implement a base with 30 extended, full-rate (EFR) GSM channels for \$3 per channel, compared to five channels at \$7 per channel with previous solutions.

—Artis Street

of compressed, digitized speech. When a call was set up, the mobile user was assigned a single vocoder resource, much like a modem is assigned.

The processing power of DSPs has grown, and vocoder algorithms have increased in sophistication. Service providers eagerly adopt each incremental advance in speed processing power because each ad-

vance allows better quality communications for their customers. However, to accommodate the many handsets in the field using early vocoders, service providers have adopted a flexible vocoder architecture that uses a pool of general-purpose DSPs to provide multiple vocoder implementations as shown in Figure 2 on page 20.

The software associated with a particular



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service provider's vocoder options is stored in the base station controller database along with information about the amount of processing resources, specified in millions of instructions per second (MIPS) and the available memory required by each vocoder.

Rather than dedicating a DSP resource on single-channel-per-resource basis, a pool of DSP resources is created. This pool consists of an array of RAM-based

DSPs such as Texas Instrument's TMS320C6X series. Each DSP can support at least a single implementation of the most complex vocoder contained in the vocoder database.

When a call is set up, the proper vocoder is selected from storage to respond to the mobile user's vocoder and is downloaded into an unused portion of the transcoder's DSP-based resource. The process is reversed in call breakdown,

which frees up DSP resources. The base station controller keeps a running total of available DSP resources and manages them accordingly.

As more powerful DSPs become available, they can increase base station controller DSP resources by the simple act of swapping out chips. The advantage of this approach over assigning one vocoder element per caller is best seen as system requirements change. When a new vocoder is adopted, the software and DSP resource consumption of this new option is simply added to the base station controller's database. There are no more changes to make. Because new vocoders appear in current access methods once every two years or so, the advantages of this programmable DSP-based approach are formidable.

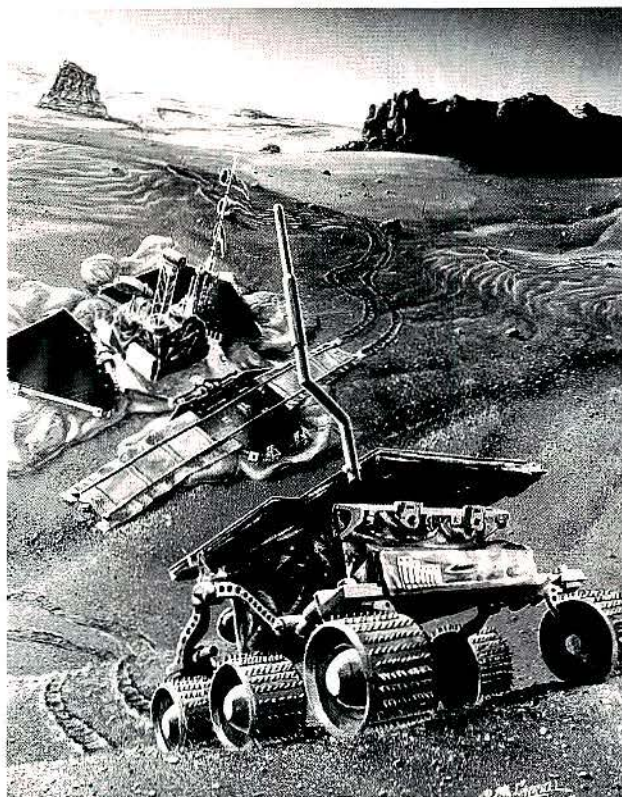
#### More power on the way

The power of DSPs is being realized in more and more areas of digital communications systems, but their capabilities have barely been exploited. Higher-speed DSPs, combined with higher levels of ASIC integration, will make an even greater impact on the modem subsystem of the base transceiver station (BTS). This will allow base stations to employ software upgrades, even active noise cancellation in the communications link, without major hardware replacement. The increased performance and higher integration of DSP ICs will also enable multiple vocoder algorithms to run on a single DSP of the transcoder, giving service providers further flexibility.

#### Software radio

The "software radio concept" promises to improve every critical-performance wireless base station parameter. In the ideal implementation of this technique, the signal is captured at its input frequency and converted at that frequency to the digital domain. Beyond this point all of the signal processing is digital, which eliminates most analog components and enables simultaneous processing of many signals to be conducted by a few DSP-based circuits.

Software radio advantages are almost entirely realized through DSP. At present, DSP technology cannot process signals directly at the input frequency of PCS systems (1.9GHz). However, it is likely that within two to three years this obstacle will be hurdled. When it occurs, the size, cost, and power consumption of PCS base stations will decline precipitously. A single base station will be configurable to transmit and receive according to the specifications of multiple air interface standards and will implement new features through changes in software alone.



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# ESMR: Integrating networks to provide commercial service

*Using digital technology, a utility provider creates a revenue-producing ESMR operation that also satisfies its own internal communications needs at reduced cost.*

By the MRT staff

Among wireless communications archetypes, utilities often build and have direct control over their own private communications systems ("Utilities As SMRs: Using Simulcast Trunking," *MRT*, July). Nor is it unprecedented for businesses to take advantage of unused system capacity by selling it as a commercial provider, as the birth of Sprint demonstrated in the 1980s. However, the Atlanta-based Southern Company, the largest U.S. electrical producer, embarked on a new course four years ago when it deliberately created an enhanced specialized mobile radio (ESMR) entity that would be principally a commercial provider, for which it would be a customer.

That course was sustained at the end of July when Southern's board of directors

committed an additional \$100 million to the continued development of its Southern LINC (long-range integrated network communications) digital communications system through the year 2005. The investment is earmarked for a variety of infrastructure improvements to improve coverage, to add cell sites and to enhance service, features and software.

"Southern LINC is currently exceeding its performance expectations, and we're confident it will continue to do so," said A.W. Dahlberg, Southern Company's chairman. "The board believes this \$100 million investment will ensure Southern LINC's development as the premier wireless business communications system."

Southern Company comprises Alabama Power, Georgia Power, Gulf Power, Mississippi Power and Savannah Electric. It also supplies electricity in eight countries and provides other energy-related serv-

ices, ranking 65th overall in the Fortune 500 list of top American corporations. Southern Company formed Southern Communications Services, which operates the Southern LINC system, in 1993, when construction began. Commercial service started in February 1996.

"We have customers in virtually every SIC (standard industry classification) code," said Julie Toland, Southern Communications Services' director of marketing. Toland said typical subscribers are businesses with a high percentage of internal communications, particularly those requiring access to both dispatch and private call functions.

Toland said that when Motorola announced its integrated digital enhanced network (IDEN) technology (*see sidebar below*), Southern realized it could be used to support a commercial business and bring in additional revenue. The availability of the digital technology was the catalyst for replacing the older radio network that was in place. By initially planning to enter the commercial market, Southern Company was able to create cost-effective access to a digital system to support the internal communications needs of its businesses.

About 78% of the traffic on the network is commercial, Toland said. The remaining airtime is billed to the utilities at a lower rate than could have been obtained from a third-party provider. The network has also captured part of the government and public safety market, such as ambulance services, because the level of system reliability required to support utility communications is comparable to those needs (*see sidebar on page 28*). Because the utility network required penetration into rural, as well as metropolitan, areas, this became an advantage in offering commercial service, which is often not available in those areas, Toland said.

Southern LINC coverage extends into four states, taking in nearly all of

## IDEN in review

Motorola's IDEN (integrated digital enhanced network) is a wireless digital technology that integrates two-way radio, full-duplex telephone interconnect, short message service and data transmission into a single handset.

To increase spectral efficiency, IDEN maximizes channel capacity by means of three proprietary Motorola technologies:

- VSELP (vector sum excited linear predictors) voice coder (vocoder) technology compresses voice signals and digitizes voice data to reduce the transmission rate. Motorola originally designed the system with a 4.2kbps vocoder that samples and digitizes voice signals to allow six time slots per 25kHz radio channel (6:1), which is still available for data and dispatch

communications. In 1996 Motorola created an "enhanced" IDEN by reducing the number of voice slots to three (3:1). An 8kbps vocoder was added to double the sampling rate and improve voice quality, particularly for telephone interconnect. ("3:1 Time Division Supports Premium Digital Voice Quality," *MRT*, October 1996.)

- M16QAM modulation technology increases data density, transmitting at 64kbps, enabling efficient data transmission in a narrowband channel.

- Time-division multiple-access (TDMA) divides the radio channel into multiple communication pathways through which segmented voice and data "packets" can be assigned a time frame and transmitted. The packets are reassembled at the receiver into the original information sequence.



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Alabama and Georgia, southeast Mississippi and the Florida panhandle. Infrastructure for the 120,000-square-mile network includes a system of 325 towers, designed to withstand 105mph winds and a half-inch of ice loading. Transmitter facilities include backup generators, eight-hour batteries and access security.

The RF coverage is subdivided into 12 geographic zones. The company offers its customers five service area choices, depend-

ing on the needs of a particular business.

Two-way dispatch, phone service and paging services can be purchased individually. At the end of 1996, Southern introduced a proprietary paging software, Textline, designed to interface with its digital system. The messaging system has also been extended to allow Internet-based messages sent through Southern LINC's Web site.

Most of the subscriber equipment of-

fered by Southern LINC consists of Motorola devices, including five handsets, offering 0.6W or 1W of output power, which can be used for private, dispatch, multiservice or industrial applications. Three versions of 3W mobile units are also offered, as well as four types of 3W desktop control stations.



## A SIMPLE COMMUNICATION SYSTEM FOR HIGH NOISE AREAS

1



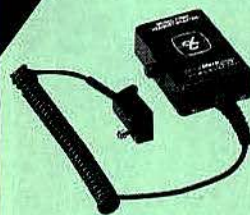
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2



NOISE-ATTENUATING HEADSET

3

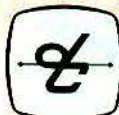


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### Trial by hurricane

Over the weekend of July 18-20, Hurricane Danny whirled out of the Gulf of Mexico and made landfall on the Gulf Coast. Bringing heavy winds and torrential rainfall, the hurricane moved slowly from Grand Isle, LA, to the Florida panhandle. It hit Mobile County, AL, on the morning of the 19th, where its winds were clocked at 80mph and it unleashed 30 inches of rain.

Southern LINC's network was used by the Alabama Emergency Management Agency (AEMA) to coordinate rescue and relief efforts during the storm. Scott Adcock, public information manager for AEMA, said the Southern LINC system was used almost exclusively for the agency's communications.

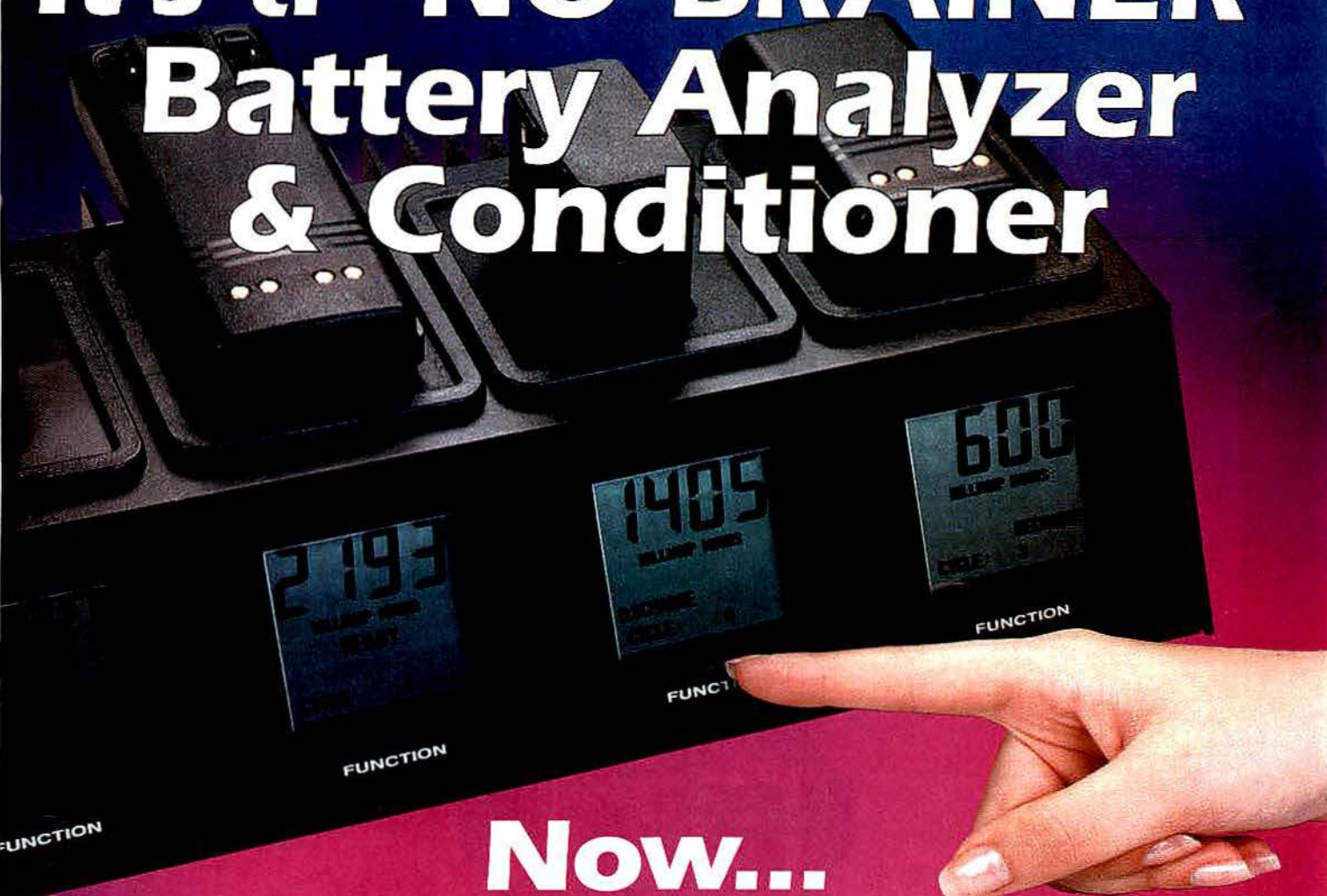
"Virtually all of Alabama's key officials kept Southern LINC handsets by their sides throughout Danny—the governor, EMA director, Department of Public Safety director and the Adjutant General of the Alabama National Guard, as well as the Department of Transportation," Adcock said.

Previously, AEMA had used cellular phones and older UHF radios but had experienced problems with dependability and mobility in the field. Using the ESMR system during the storm, AEMA designated a talk group in the hardest hit areas to quickly relay information to multiple points.

"Southern LINC was essential in our search and rescue missions," Adcock said. "When local 9-1-1 operators received information from residents about rising waters, they relayed it to our county EMAs, who then used LINC handsets. This gave us an important edge in providing additional support to the National Guard, volunteer fire departments and other volunteers."



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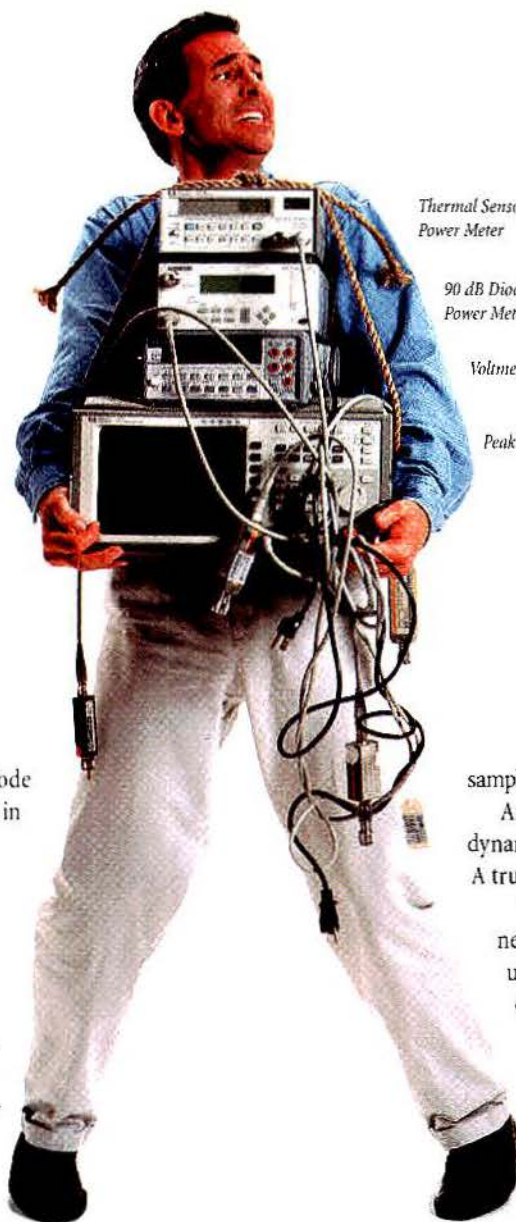
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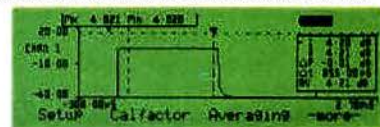
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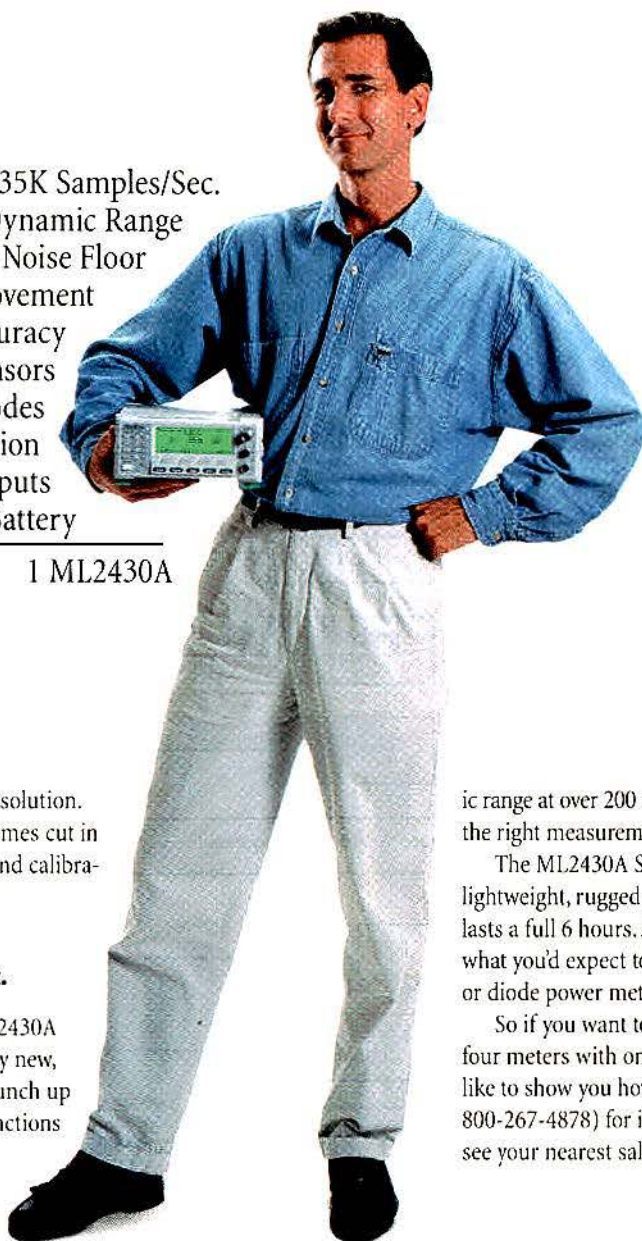


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1 ML2430A



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# Operation Gold Star

*Resourceful interconnection of law enforcement radio resources can support communications for coordinated tactical operations. Delays in vox detection for cross-channel rebroadcast can be circumvented.*

By John Downing

With "Operation Gold Star," the idea is simple. Ask for volunteers from police, deputy sheriff, highway patrol and numerous state and federal agencies to participate in an evening exercise. Then ask the respective departments to commit their officers for one or two evenings a month to make up a task force to sweep through communities looking for gang activity, drunk drivers, parole and curfew violations. These officers would also check on suspicious vehicles, expired vehicle registrations and unlicensed drivers. Do you think there would be any takers?

You bet there would be! Not only has there been a tremendous acceptance on the part of the communities within Fresno County, CA, but there is actually a waiting list of officers wanting to participate in the Gold Star operation, which is conducted monthly within Fresno County.

With so many agencies involved, how

does one retain control of this massive influx of law enforcement resources? Operationally, the Fresno County sheriff assumes control of the task force, providing dispatching, computer resources and radio support.

But what about the radio resources? Each agency must furnish its officers with communications equipment. Unfortunately, not all radio communications equipment is directly compatible. Although many agencies operate on VHF highband, the larger cities of Fresno and

Clovis, CA, operate on UHF. So how do all of these officers communicate with each other?

Certain common radio frequencies exist to allow law enforcement mutual aid communications to occur. Within California, the state has licensed both VHF and UHF frequencies as the California Law Enforcement Mutual Aid Radio System (CLEMARS). These channels allow agencies to cross-communicate with each other within a single frequency band; however, no provision is made to cross-

## Results of Fresno County Gold Star, conducted July 11 & 12, 1997

Felony arrests .....	31
Misdemeanor arrests .....	163
Drunk driving arrests .....	35
Juvenile arrests .....	10
Vehicles towed .....	54
 Total personnel .....	 107
 Field interviews .....	 175
Gang interviews .....	79
Curfew violations .....	49
Citations .....	130
Weapons seized .....	11
 Agencies represented .....	 14

John Downing is the telecommunications engineer for the County of Fresno, Fresno, CA.

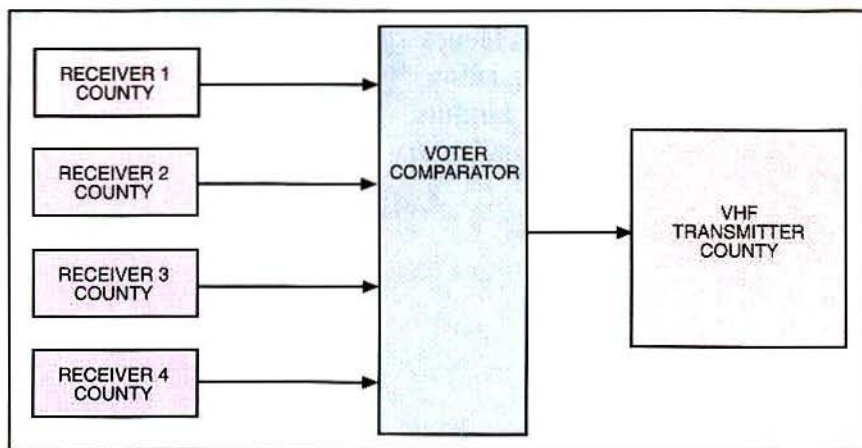


Figure 1. VHF radio system

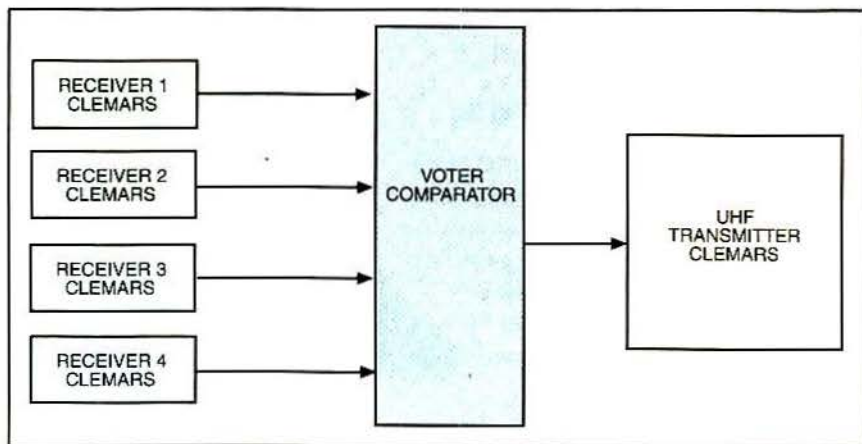
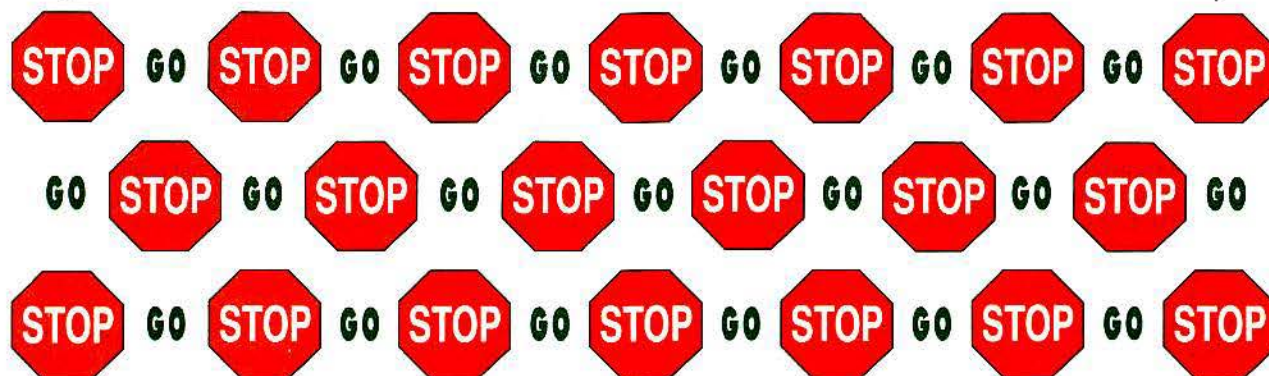


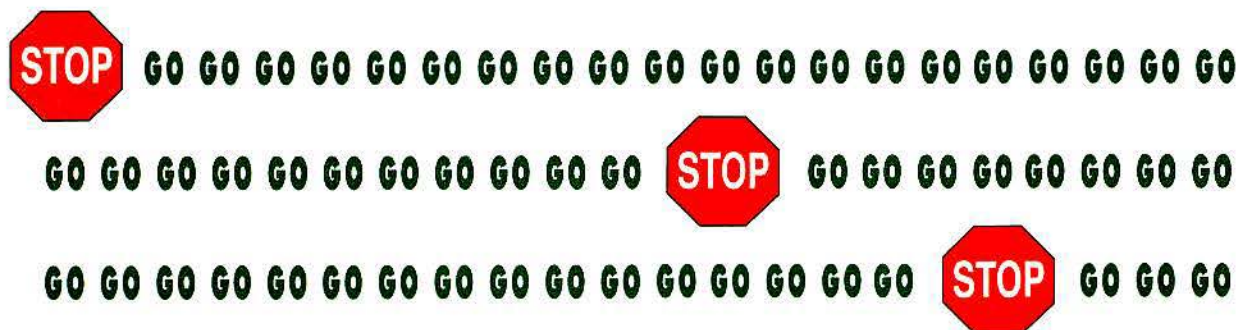
Figure 2. UHF radio system



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communicate *between* bands. The problem of how to "link" VHF and UHF channels still exists.

Both Fresno County and the city of Fresno use systems of repeaters with auxiliary receivers connected to them. These receivers are electrically selected by a receiver comparator, sometimes called a voting comparator. A simple block diagram is illustrated in Figure 1 on page 32.

New-generation dispatch consoles contain electronics known as "cross-channel rebroadcast." Receive audio is detected and assigned, by the dispatcher, to another channel. The console provides the audio detection and transmitting protocol, such as direct current or tone keying. The biggest drawback to cross-channel rebroadcast is that all detection is done by voice activation vox. The audio must be present before it can be detected. Because of the time required for the console to activate the selected transmitter, the first or second word of the transmission is usually lost. With soft-spoken officers, or an officer that pauses significantly while talking, the system drops off and must be reactivated, repeating the cycle. Law enforcement radio transmissions are brief. Channel rebroadcast using this system of

vox circuits has proved unacceptable for the Fresno County Sheriff.

Rather than having the voting comparator look at an individual receiver, and then select it into a system, what would happen if an entirely separate radio system were connected as though it were merely an individual receiver? That receiver could then be connected into the existing channel, with both system audios being routed to the repeater output. The voting comparator would act as an audio mixer, routing the respective channels back to the dispatcher and then allowing audio to be connected back to the respective repeater, as shown in Figure 2 on page 32.

The voting receiver is receiver-activated, as opposed to voice-activated, so as soon as the officer transmits, the patch is activated and remains online until the transmission is completed. The previous problems of transmission dropout and loss of first or second words of the transmission are eliminated.

The Fresno County Sheriff and the city of Fresno committed support to Operation Gold Star, and each agency made one radio channel available. The city committed a UHF channel, and the county committed a VHF channel. All highband us-

ers were granted operational authority by the sheriff to operate on the county-wide VHF tactical channel, while the cities of Fresno and Clovis operated on the city of Fresno UHF CLEMARS system under the California state license.

A simple interface, dubbed a "receiver simulator," was built, allowing the city's entire UHF radio channel to look like an individual receiver on the county's VHF radio system.

Fortunately, Fresno County and the city of Fresno had dispatch centers located across the street from each other. For preliminary testing, a short length of telephone cable was suspended between the two buildings that housed the telephone cable for each agency. Audio from the

### **California public safety agencies adopt cooperation plan**

Earlier this year, California's 10 largest public safety agencies adopted the California Public Safety Radio Communications Strategic Plan. After problems with the current radio systems such as aging equipment, channel congestion, limited functionality and lack of interoperability, the public agencies decided to frame a common vision in which modern mobile communications technology would enhance the delivery of public safety services into the 21st century. The goals included:

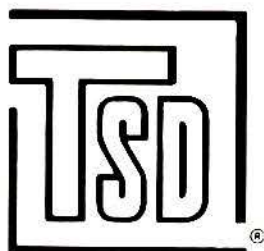
- ❑ *universal statewide access.* Basic radio communication capabilities must be available to all public safety service providers as they travel throughout the state.

- ❑ *improved interoperability.* Agencies must be able to communicate with one another.

- ❑ *enhanced functionality.* By 2010, data and image transmission will account for the majority of all public safety communications.

- ❑ *channel availability.* Additional spectrum, greater spectrum efficiencies and system expansion are required to ensure that public safety personnel have immediate access to communication channels.

The Warner Group, a consulting firm in Woodland Hills, CA, wrote the strategic plan in cooperation with the agencies. In committing to a partnership, saving money and using new technology, the public safety agencies' main goal is to secure the safety of California's residents and visitors.



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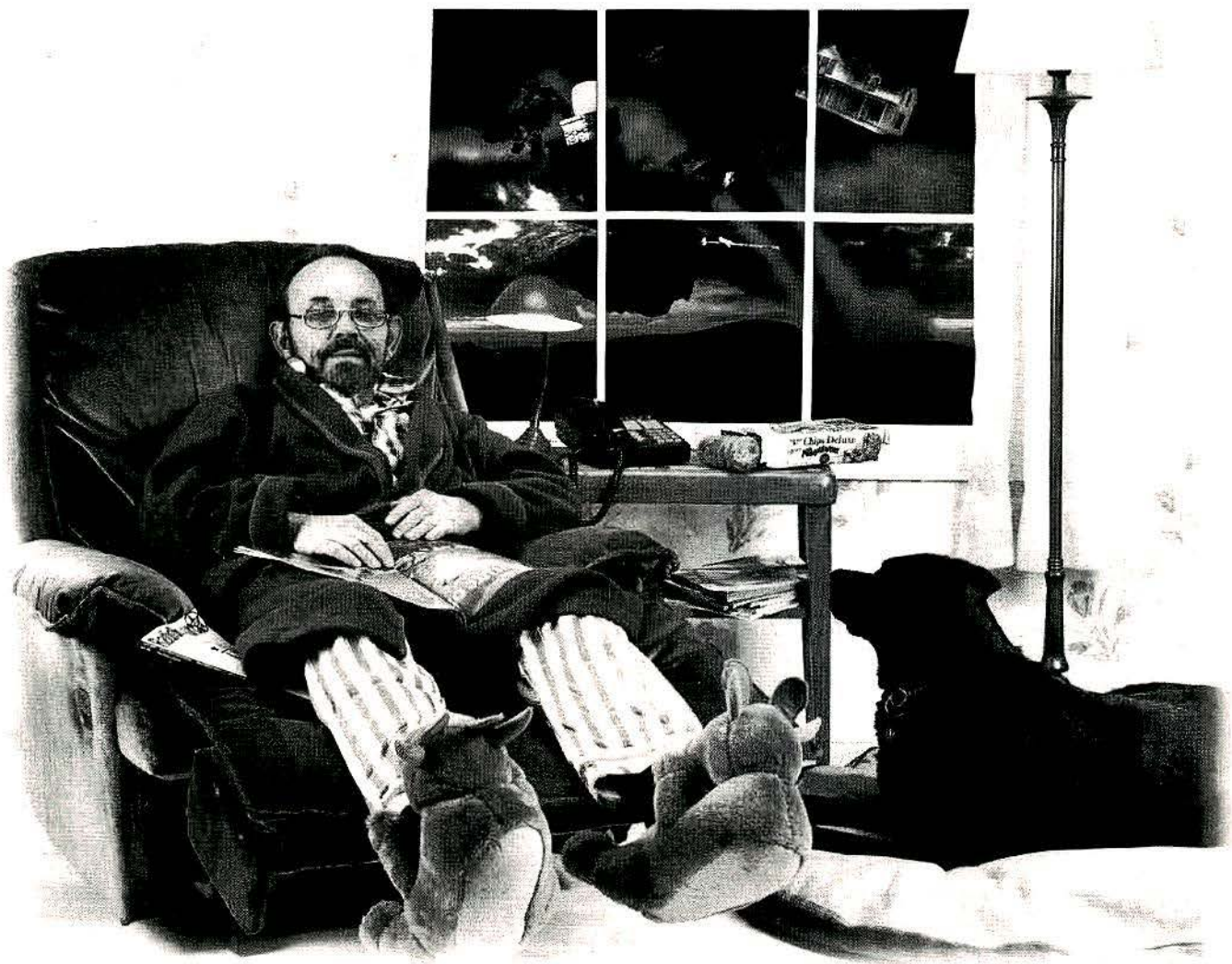
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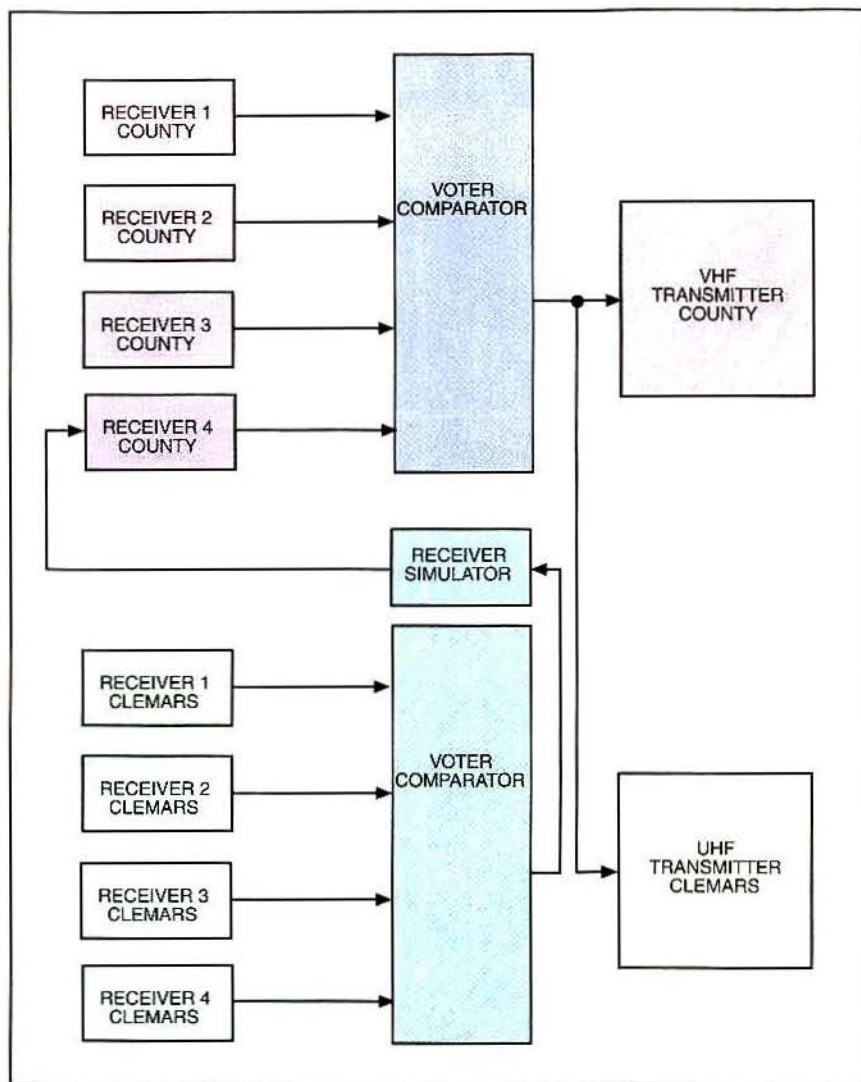


Figure 3. VHF and UHF radio system

city's system was connected to appear to the system as if it were a county receiver, while audio containing the county's repeated car-to-car and dispatcher audio was returned to the city and connected to the city's transmitter. Only two pairs of wires were needed to complete the patch. Audio levels were set, and the system was up and online.

The Operation Gold Star patch has been so successful that permanent cable is now being run to replace the temporary cable. While current connection and disconnection of the patch is made both at the city and county communications centers, provisions are now being made to allow the dispatchers of each agency to turn the patch on or off at will.

This system could allow for additional inputs from other agencies to be accommodated. Theoretically, the number of agencies would only be limited by the number of receiver voting modules available and the number of receiver simulators constructed on the system. Using a voting comparator as an automatic mixer results in a simple, yet effective, way of combining multiple systems into a single, multifrequency system allowing cross patching of users from one frequency band to another.

Operation Gold Star represents an example of how separate government agencies and multiple jurisdictions can join to achieve a common goal. While the radio staff of the city and county accomplished a technically difficult project with excellent results, the real winners are the citizens of the city and county of Fresno who now benefit from the increased law enforcement presence and resultant reduction in crime.






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## Technically speaking

(continued from page 8)

When using coax cable, a BNC Tee connector is needed. The oscilloscope connects to one side of the Tee connector and the transmission line to the other side. When twisted pair cable is used, the twisted pair connects to the binding posts, and the oscilloscope to the BNC jack. In this case a 50Ω cable is connected to the reflectometer. Figure 2 on page 8 shows

several waveforms for various load impedances. The TDR will provide the distance to the fault if you enter the time delay between the incident and echo pulse. For example, if you examine the timebase of the scope and determine that the time between the incident pulse and the echo pulse is 400ns, just enter the number 400 into the reflectometer, and it will return the distance of 130 feet. If you use an oscilloscope, make sure that the

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Photo 1. A time domain reflectometer helps locate cable faults that may show up in strange places.

time base is accurate. Otherwise, your distance calculations will be inaccurate. Usually, we are looking for the distance to a major fault—open or short circuit. For this application an oscilloscope is not needed. The oscilloscope is only needed for locating minor reflections or for observing the echo waveforms.

### Selecting the transmission line

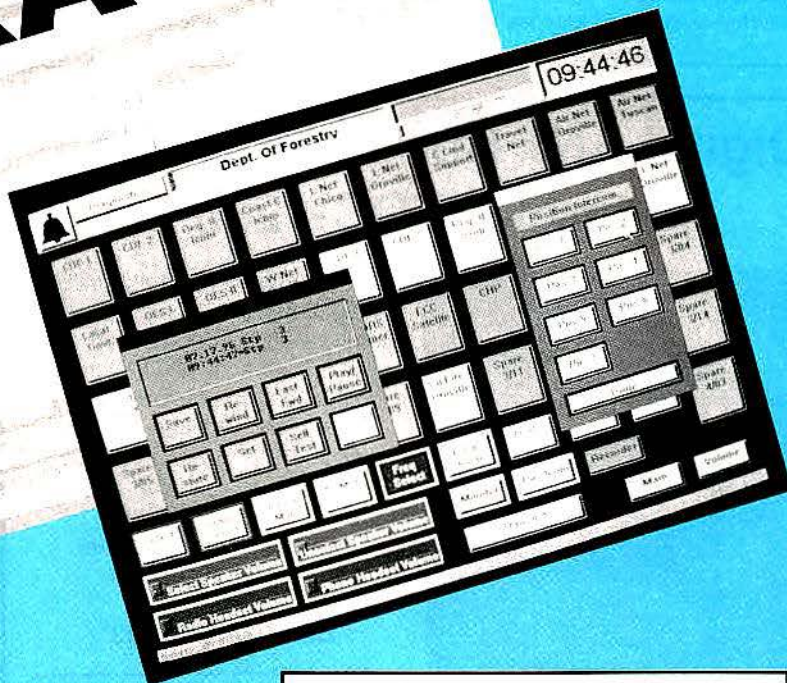
As many as 96 transmission line types can be stored in the reflectometer for instant recall. The unit comes preloaded with many lines. You can add transmission lines by setting up the characteristic impedance, velocity factor and then storing under a name you choose. A BNC jack is used for connecting coaxial cables, and binding posts are used for connecting twisted-pair lines. The binding posts apparently connect through a balun that provides a 4:1 impedance change. To test a 600Ω balanced line, the line would connect to the binding posts, and the impedance would be set to 150Ω so that when passing through the balun, the impedance would be transformed to 600Ω.

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## Technically speaking

along with other vital information. The echo is plotted, and a cursor is provided to enable an examination of the echo(s). Upon placing the cursor over the echo, the information is provided on the screen. Information such as distance-to-fault and return loss of echo (an indication of the severity of the mismatch) is provided.

### General information

The reflectometer can locate faults from

16 feet to 2,000 feet (5 meters to 600 meters). Faults less than 10 feet apart can be resolved on the display. Accuracy is rated at  $\pm(1\%+2')$ . For example, at 200 feet the accuracy would be  $\pm 4'$ . Characteristic impedance for coaxial cable is  $45\Omega$  to  $150\Omega$  in  $7\Omega$  steps. For balance line (two-wire cable), the characteristic impedance range is  $180\Omega$  to  $600\Omega$  in  $28\Omega$  steps. The velocity factor range is 30% to 99% in 1% steps. The output pulse is +5V with a pulse

duration of 25ns. The unit can run with supplied ac power supply or a battery pack (8 AA cells). Battery life is about 12 to 14 hours. Cable types and plots along with modes, settings and calibration data are stored in non-volatile memory. A serial port is provided for connection to a computer for use with optional software. The unit weighs slightly over 1.5 pounds including batteries.

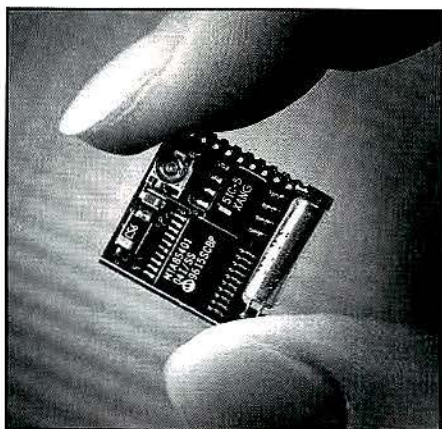
### Summary

The CableMate TDR is user-friendly. In an hour or so one can become sufficiently familiar with the unit to make useful measurements with it. The menu is easy to understand, and condensed instructions are printed on the back of the unit. Such an instrument is useful for making reference measurements on transmission lines for future maintenance reference, as well as for determining line length, velocity factor and fault locations. For further information on this instrument, contact Advanced Electronic Applications (Division of Tempo Research) 1221 Liberty Way, Vista, CA 92083. Phone: 760-598-9677.

Until next time—stay tuned!



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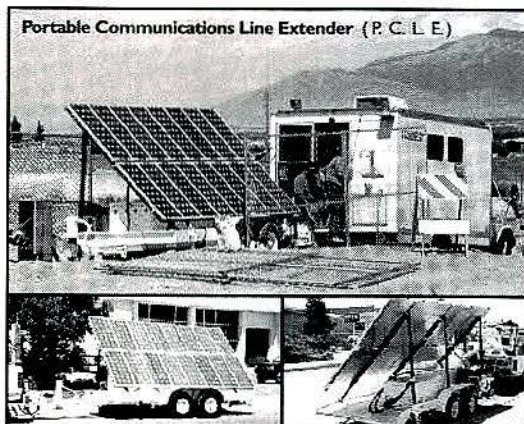
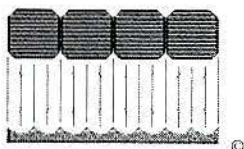
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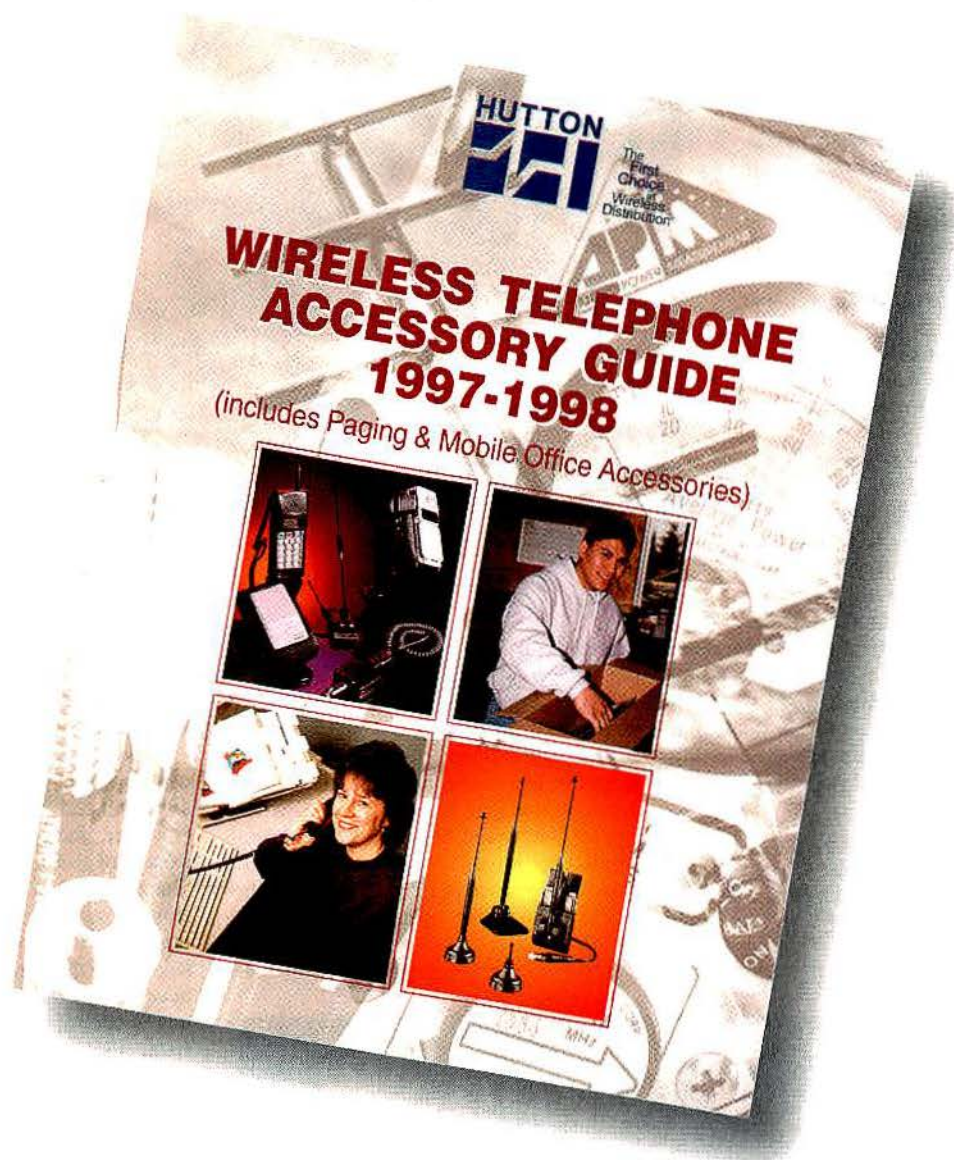
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## Carving the pumpkins

By Robert H. Schwaninger Jr.

It's Halloween, and the time for tricks and treats is upon us. The scary time when the nights are a little darker; the trees wave naked, gnarled branches in mysterious ways; and the howl of a far-off, soulless creature could be getting closer. . . coming for *you*. With the creak of an old door opening into a pit of inky darkness, out leap the horrific monsters that seek to devour us all. Pranks and portents of something more sinister fill the air in a whirl of broomsticks and banshees.

But it's all make-believe, right? Carved pumpkins and bed-sheet ghosts to scare little kids and give adults a few laughs is all it is. No one gets hurt, and everyone gets an adrenaline rush, with pounding hearts and a hearty guffaw. However, what happens when it's all a bit more real? What happens when the tricks and treats are found in pages of FCC orders and Congressional actions? How about if the tricks being played are threatening your livelihood, or denying the rights of

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.



**"BOY, THEY'RE RIGHT... IT IS HAUNTED!"**

operators, or simply are not funny? What then?

Over the past months, the industry has witnessed a lot of tricks by regulators and policymakers. Some are so silly that they resemble legislative prat falls. Others are a pie in the face to two-way shops and paging companies. Some tricks are scaring small operators into believing the graveside manner of many advisors. Other "tricks," more like hounds from hell, are

visited upon well meaning people. Here are a few:

### Pumpkin heads

This year Congress declared that in the next few years, the Balanced Budget Act of 1997 will end the onslaught of federal debt. However, one of the cornerstones (or headstones) of that legislation is the expectation that the FCC will raise 20 billion bucks from more auctions. Congress did not explain who was going to pay this enormous sum, since the biggest players in the market have already made their purchases in previous auctions, or have been made exempt from auctions. So where are all these simoleons coming from? It must be magic.

### The undead

In devising its orders for auction of 800MHz channels, the FCC created the possibility that unconstructed channels might be used as trading stock in frequency migrations. What the agency didn't make clear is whether the trading licensees could use channels for which the construction period had run out, thereby automatically canceling those licenses prior to the trade time. It appears that the FCC thought you could bring these licenses back from the dead, as long as they were kept on ice in a spectrum warehouse.

### Vampires and double-crosses

To avoid further debacles in defaults on installment payments, the FCC is attempting to eliminate this option for small business. The PCS Block C winners have sucked

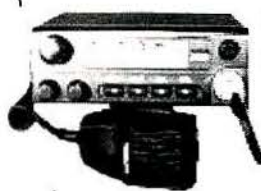


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## Regulating technology

the lifeblood out of the federal government's political marketing coup by failing to pay up promptly. To avoid the batty results that have followed this public nightmare, the FCC is warding off future problems by putting forth a double cross in denying legitimate operators this financing opportunity.

### Booby traps

Congress opened up the door for the use of *reserve bids* in future auctions. Rejecting

the use of simple market economics and trying to preset a value for spectrum, Congress hoped to avoid repeating the embarrassing results of the Wireless Communications Services (WCS) auction. But did you know that the FCC doesn't have to *publish* the reserve price on spectrum? Think you got a bargain at the auction? Gotcha!

### Fortune tellers

The FCC has admitted, repeatedly, that

prior to announcing an auction, it does not know whether there will be mutually exclusive applications. But the Telecommunications Act says that auctions are supposed to be used only where mutual exclusivity exists, and that the agency is to avoid incidents of mutual exclusivity, using all of the tools at its disposal. So, how can the Commission know in advance that mutually exclusive applications or bids or both will be forthcoming, unless the agency's actions are really causing the problem? Somebody's dealing off the bottom of the deck of tarot cards.

### Goblins

Through a series of interesting maneuvers, the high-definition television (HDTV) spectral scene has become the digital television program. That six "megahurts" of spectrum that has been tithed to the political forces of the goblin' media is no longer simply for the delivery of HDTV. Now, transformed under the full moon, it is spectrum that can be employed for multichannel digital television. The intended investment in improved service to

*That six 'megahurts' of spectrum that has been tithed to the political forces of the goblin' media is no longer simply for the delivery of HDTV.*

the public has quietly been morphed into greater system capacity, without concurrent benefits in signal quality. The icy fingers of the broadcast establishment are still firmly about the throat of Congress.

Yes, some scary things are happening here in Washington, where the ghosts of logic and fairness wander the halls of Congress and the basement of the FCC, without a home and in fear of being permanently exorcised. The tricks outnumber the treats, and the advisors act like pod-people, without emotion, fear or compassion. One wonders when the people in the village will carry pitchforks and torches—and votes—to the castle of government to destroy the evil within.

For now I simply point up the weird and unexplainable mysteries that surround the acts of government, priding myself on the fact that I got through this entire column without once mentioning the big blue bat.



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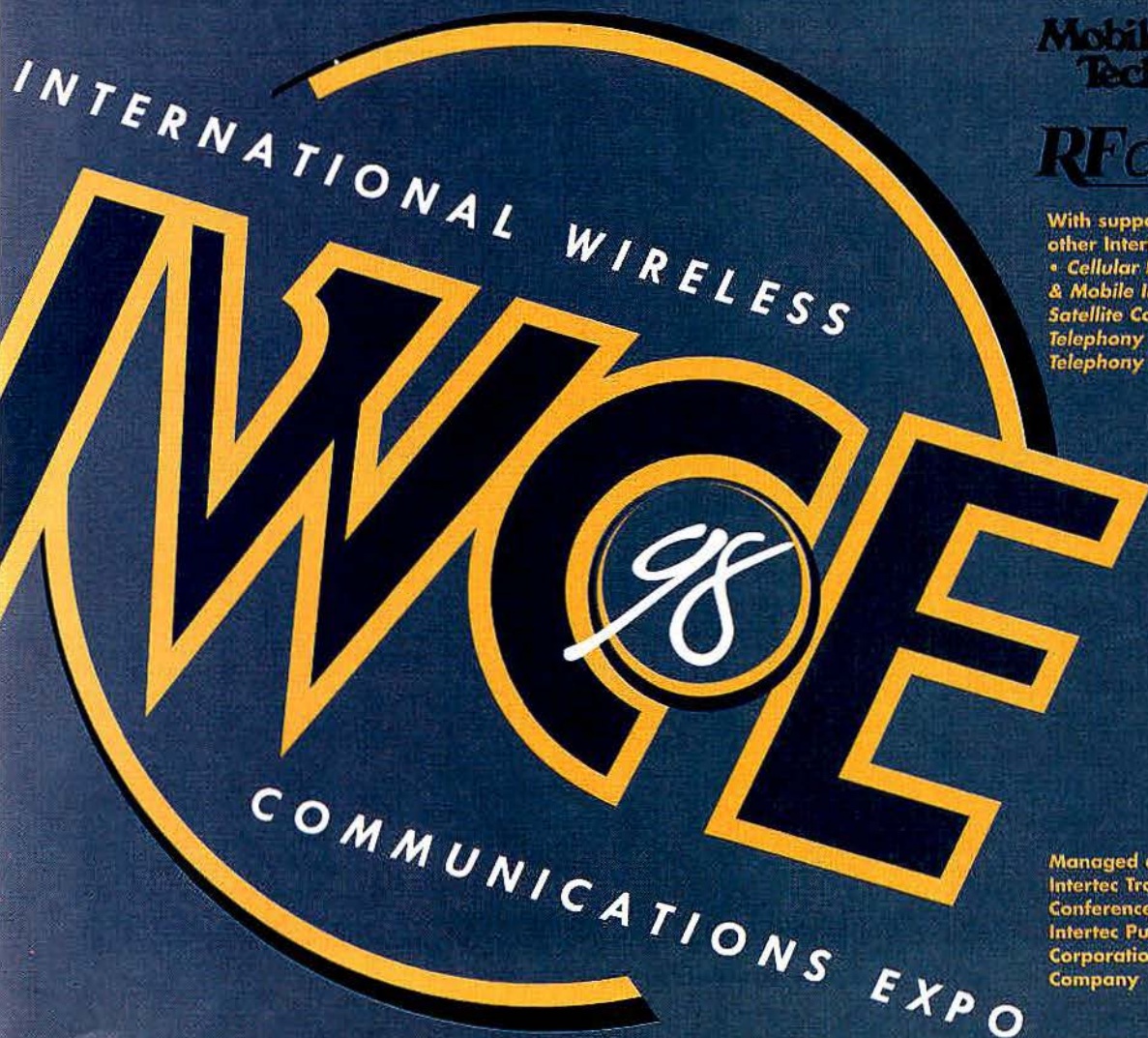
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## Industry associations appeal FCC's announced SMR auction

The FCC's announced auction of SMR channels is drawing heavy fire from a number of sources as parties line up to take a shot at the agency's proposed rules for auctioning 800MHz channels. The matter has spawned two appeals to the U.S. Court of Appeals for the District of Columbia seeking overturn of the FCC's decisions.

A group of 38 operators represented by Brown and Schwaninger, Washington, DC, has filed appeals to both the FCC's Memorandum Opinion and Order and its Second Report and Order. In a separate appeal, the trade group SMR-WON is also opposing the agency's decisions. Industry observers expect the appeals to be con-

solidated before the Court.

Major paging companies, such as AirTouch, Dallas, are also seeking to intervene in the appeals, stating that they believe the issues to be decided may affect any future auction of paging channels, including the agency's authority to engage in the auction of encumbered spectrum. Nextel Communications, Rutherford, NJ, has filed papers with the Court asking it to turn down the appeal.

Meanwhile, the FCC has received numerous petitions for reconsideration to those same decisions. Small Business in Telecommunications (SBT) has noted that the decisions do not conform with law, including new sections of the Telecom-

munications Act adopted in August 1997. Industrial Telecommunications Association (ITA) states that the FCC's plans do not conform with its Congressional authority. AMTA points out that the FCC's rules unfairly eliminated installment payments. PCIA seeks substantial revision in the FCC's decisions, including a recognition of costs to customers in participating in any frequency relocation.

The announced date for the auction is Oct. 28, but thus far five associations have requested reconsideration of various parts of the FCC's scheme, and the agency may yet take the opportunity to address those problems prior to holding the auction.

## S.C. Basnight wins PCIA's 1997 Technician of the Year award

The PCIA honored S.C. Basnight with its annual Technician of the Year award on Sept. 9, at the Board of the Directors' Dinner and Industry Awards Ceremony during the association's Personal Communications Showcase in Dallas. The award is given in recognition of "consistent demonstration of exemplary technical performance." Basnight has worked for Commercial Radio Service, Nags Head, NC, for 35 years, and is now man-

ager and head technician.

Basnight's achievements during almost four decades are numerous. He installed the E9-1-1 system for Dare County EMS and the Centracom system used by county EMS, fire, police and sheriff's office. He also installed equipment for Pasquotank County's Command Center, a mobile communications base communicates with all emergency units needed to maintain an area during an emergency or disaster. Per-

haps more valuable than his achievements, however, are his day-to-day presence and reliability. He is on call 24 hours a day to ensure that the equipment is operational.

In a letter to the PCIA, Dare County Communications Director David Cowan described Basnight as a "tremendous asset" to the county. "I work with numerous service providers," Cowan said. "Of these providers, none are as pleasurable, competent or resourceful as Mr. Basnight."

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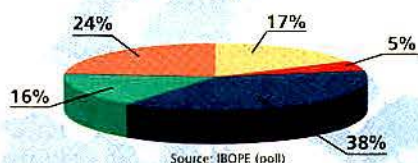
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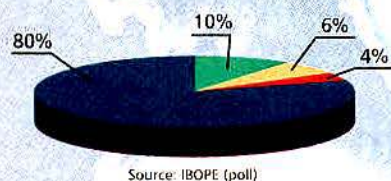
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### Test procedure verifies pager coverage using GPS, computer link



Skyword Plus units, a GPS receiver and a palmtop computer were used in verification of pager coverage.

Mobile Telecommunications Technologies (Mtel) has certified paging coverage in 30 cities, under real-life conditions.

Rather than rely on computer-generated coverage forecasts typical in the industry, Mtel teams were dispatched to key markets to determine and to certify coverage for Skyword Plus, an advanced messaging product.

"Mtel has implemented an on-site testing program that provides scientific validation of our coverage areas," said John T. Stupka, Mtel president. "Traditionally, the industry has determined the coverage area in a market by generating forecasts based on theory—totally ignoring weather conditions, topography and building penetration."

Equipped with one-way pagers,

Skyword Plus units, global positioning systems (GPS) receivers and HP200LX palmtop computers, the teams crisscrossed the city throughout the day, going to more than 400 randomly chosen locations, both inside and outside of buildings.

For the next 12 hours, each paging unit was sent messages generated by the SkyTel Network Operations Center (NOC) in one-minute increments. Simultaneously, at 20-second intervals the GPS receivers pinpointed the test latitude and longitude coordinates and relayed the information to the HP palmtop.

These data were downloaded to a laptop and emailed to Mtel's corporate headquarters in Jackson, MS, at the end of the day. The GPS data files were then compared to the percentages of message receipts on the pagers to verify actual coverage.

"During the certification process, the NOC sent more than 1.9 million messages, allowing us to accurately verify and define total market coverage," said Ali Tabassi, vice president of RF network operations and engineering at Mtel. "In the next few months we will be sending teams back out to certify markets for other SkyTel products."

Skyword Plus was released in April and

features guaranteed message delivery. If a subscriber turns a pager off or travels out of range, the system stores the messages. When the subscriber returns to the coverage area or turns the pager on, the system delivers all stored messages automatically. An additional feature, Messagemender, automatically corrects garbled messages.

### ITLA assigns frequency advisory activities to ITA supervision

The International Taxicab and Livery Association (ITLA), Kensington, MD, is now under formal agreement with the Industrial Telecommunications Association (ITA) for the day-to-day management of its FCC-certified frequency advisory committee activities. The activities will be performed by ITA at its offices in Arlington, VA.

ITLA plans to continue to maintain an active role in all future spectrum management and regulatory initiatives through the formation of an ITLA and ITA jointly managed Taxicab and Livery Communications Council that will be governed by taxicab and livery license representatives.



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## PCS network construction increases need for recruiting, training technicians

Personal communications service (PCS) wireless telephone licensees, also known as "carriers," use a combination of resources to find and to recruit people with skills to build and operate their cell sites and switching offices. Universities, colleges and trade schools provide graduates who are ready to be trained to work with specific equipment. Training is typically offered by vendors, consultants, contractors and the carriers themselves.

WirelessNorth, a PCS management company owned by independent telephone and utility companies that own PCS licenses in Minnesota, Wisconsin, North Dakota and South Dakota, already has activated some of its PCS systems. Asked how the carrier finds training vendors, company president Rick Rappé said, "When you announce plans to spend \$40 million to build a network, the vendors come to you with training." Training is often conducted at the vendor's facilities, with several customers sending employees to the same classes. "The training generally is not conducted at schools, hotel locations or trade shows," Rappé said.

Robert C. Shapiro, P.E., president of Strategic Telecommunications, Carrollton,

TX, said carriers typically run through a cycle from the highest-priced to the lowest-priced technical talent as the network moves from design through construction and to routine operation. "First come the lawyers and engineers, who bill at rates approaching \$100 or more per hour," he said.

After the license application and system design stage, vendors are selected to build the system. Carriers use their own employees, contractors, vendors' employees and their contractors or a combination. Strategic Telecommunications is a contractor that normally works for vendors and carriers.

"Once the system is built, the vendors and contractors normally are let go, with the exception of a few key representatives for a year or so to handle remaining work and to train the carrier's employees," Shapiro said.

When their systems have become operational, carriers typically continue to shift from reliance on consultants, vendors and contractors to reliance on full-time employees as their training is completed and as they gain experience.

"Carriers naturally want to reduce their operating costs, show a profit and amortize their capital investment," Shapiro said.

"Full-time technician salaries typically range from \$40,000 to \$80,000, which is less than it costs to use outside services to accomplish the same tasks."

Bob Beers, WirelessNorth's director of engineering, has recruited experienced employees from other carriers. In addition, he has hired graduates from Western Iowa Technical Community College in Sioux City, IA, and he has used a recruiting service for at least one other hire in a technical capacity. "We fill in a crew with one experienced technician and one or two others, with no experience, who are fresh from trade school," Beers said.

Whereas Rappé finds that most technical sessions offered at trade shows to be too general in nature and too sales-oriented, compared to training conducted at the vendors' facilities, Beers has found that some specific topics are covered well.

"Vendors of dc power systems for cell sites, antenna vendors and test equipment vendors often offer seminars at trade shows that help us with our jobs," Beers said. Shapiro said a key difference is the limited opportunity for hands-on training at trade shows with the switches, transmitters, receivers and other network equipment.



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### D&L Communications purchased by management employees



Murphy



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D&L Communications, Fort Wayne, IN, has changed ownership after 34 years. Dwight Donaldson and Bruce LeVasseur, co-founders of D&L Communications, have announced their plans to sell the company to key employees Tom Murphy, vice president, and Kevin Stock, marketing manager.

Murphy will assume the position of president, while Stock will serve as executive vice president. Murphy and Stock will own the company jointly. Common stock options will be extended to members of the current management team.

Immediate plans call for an aggressive expansion of their SMR division, which now has more than 235 channels.

### Technician group changes name, refocuses membership

The Association of Communications Technicians, a membership section of the Personal Communications Industry Association (PCIA), Alexandria, VA, has changed its name to the Alliance of Wireless Communications Engineers and Technicians (AWCET). The 850-member alliance previously had focused on the needs of technicians, but it is expanding its scope to include matters that are important to engineers involved with radio-related communications infrastructure and user devices.

"All along, we have offered services that are useful to wireless communications engineers as well as technicians, but the previous name might have deterred some engineers from considering membership," said Ian Wright, vice president of sales and service for Dominion Communications Systems, Colonial Heights, VA. Wright is a current member of the alliance's volunteer leadership council, a former chairman of the council and a current member of PCIA's board of directors. "We want to market the alliance's services to engineers as well as technicians, and the name change reflects this direction." Information about AWCET is available by calling 800-759-0300.

### Decibel Products opens environmental stress testing facility

Allen Telecom's Decibel Products Division has completed design and installation of facilities for environmental stress screening at its headquarters and manufacturing facility in Dallas.

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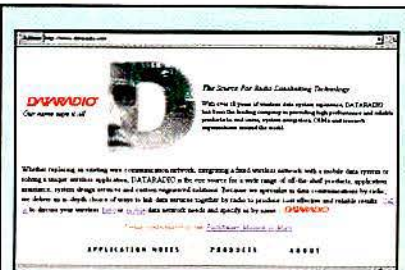
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## Mobile Radio Technology

The MRT Web site can be used to submit signed letters of comment to the "Letters from Readers" section via editorial email. Watch for the MRT resource center on the Web site in 1998. Visitors to the Web site can learn more about Intertec Publishing's other communications magazines, such as *Cellular & Mobile International*, and shows and conferences, such as IWCE '98 in Las Vegas.

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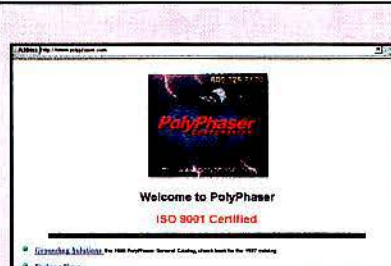
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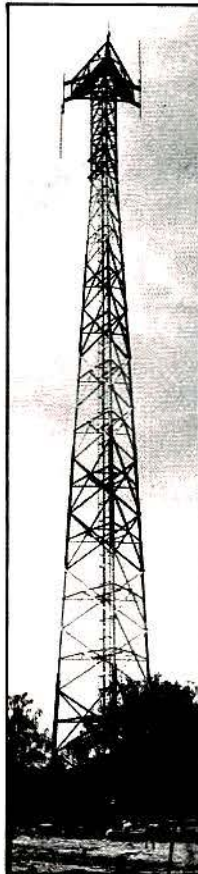


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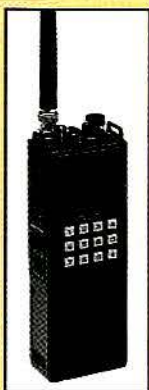
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## Readers' choice

Of all the new products and services in the April 1997 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

### Portables feature rugged housing for public safety use



The HSX series portable radios from Haewa feature rugged die-cast metal housings that make them suitable for public safety, law enforcement, industrial and commercial applications. The radios are available in lowband, mid-band and VHF frequencies. Features include 16 programmable channels, wideband operation, DCS, CTCSS, full scan, priority scan, cloning and PC programming. Controls are mounted on top for easy access. Options include speaker mics and vox hands-free ear mics.

Circle (500) on Fast Fact Card

### Filters reduce noise on 12V equipment, available in 3 models



ICT's power conditioning modules are available in 12A, 25A and 40A models.

These rugged conditioners filter out differential and common mode noise present in industrial equipment, automobile and marine electrical systems. They filter both the positive and negative leads, have an input voltage range of as much as 100Vdc and a filter frequency range of as much as 200MHz. These filters are compact, lightweight and provide a way to reduce the noise on some 12V equipment.

Circle (301) on Fast Fact Card

### Control system interconnects various communications systems

The JPS Communications ACU-1000 features a modular approach to controlling and interconnecting various types of communications systems. Its basic components are interface modules, each designed to connect a specific communications medium (VHF and UHF radio, telephone or satcom, HF radio, local operator), a control module, a power supply module, a chassis to accommodate the modules, and a back plane to route audio and control signals between modules. The interface modules convert communications traffic into its essential

elements: receive and transmit radio, and accompanying control signals required to fully control the device that the module is interfacing. For example, the PSTN-1 module interfaces with standard telephone lines. It converts two-wire phone line audio into four-wire send-and-receive audio, interprets call progress tones and provides a vox output to notify the system when the PSTN caller is talking. It decodes DTMF tones coming in over the phone line and sends out DTMF or pulse dial signals.

Circle (302) on Fast Fact Card

### Internal receivers collect signal strength data for paging systems

Advanced Signal's receivers allow Signalpro users to collect signal strength data to complement the existing error rate logging information. Users may now collect bit-error rate (BER), code word error rate (CWER), peak edge error (PEAK) measurements, and signal strength (RSSI) measurements at the same time. The first two receivers cover

the 917MHz-950MHz frequency range. One receiver has a 15kHz IF and is suitable for paging systems that employ 4.8kHz deviation settings. The other receiver has a 7.5kHz IF and was designed for systems that have 2.4kHz deviation settings, specifically Reflex25/50 and Inflection.

Circle (303) on Fast Fact Card

# zap.

**A split second and it's gone—A lightning surge has struck.**

Telecommunication systems need reliable, maintenance-free protection capable of surviving harsh conditions. That's why Cutler-Hammer offers a complete line of lightning and surge protectors for PCS, cellular, paging and microwave facilities. Our exclusive designs, including telecommunication panelboards (with manual or automatic transfer switch and surge protection), rectifier and quarter wave protectors, are the most reliable available.

Lightning doesn't have to get you down. Cutler-Hammer's surge protection devices make sure it won't.



**Cutler-Hammer**

**E.T.N**

Circle (55) on Fast Fact Card

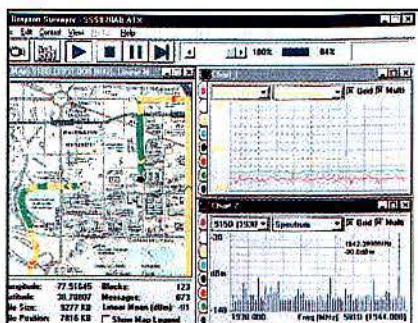


## New products

### Drive test and measurement system maps signal strength and coverage, tunes RF propagation models

Spectrumtracker Elite from the Grayson Electronics Division of Allen Telecom is an advanced drive test and measurement tool that gives wireless system designers the ability to map signal strength and coverage, tune RF propagation models, make interference measurements, clear microwaves and perform channel occupancy studies. The system provides continuous wave (CW) measurement capability with real-time display and logging of such CW parameters as linear mean, maximum and minimum RSSI. Data displays include real-time map, time domain chart and numeric formats. Users may also view real-time power density function and spectrum analyzer displays. The system provides an open log file format and supports internal or external GPS and dead reckoning with optional differential GPS.

Circle (304) on Fast Fact Card



### Headsets allow hands-free operation



RadioMate's lightweight headsets offer hands-free ability to communicate, which allows the user the freedom to perform other tasks while handling telephone and dispatch functions. These products are offered in three models, including the over-the-head single ear cushion and two lightweight self-supporting models, all of which can be worn on either the right or the left ear. Some

models may require an optional adapter with a 2.5mm jack.

Circle (305) on Fast Fact Card

### Hotplate system features wide area, uniform heating

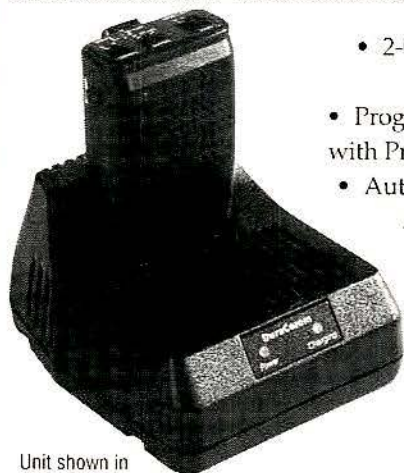
Automated Production Equipment's wide-area radiant surface (WARS) hotplate offers a large size, with a 12"×12" heating area; a broad temperature range with a peak temperature of 500°F; and thermal uniformity with a variation no greater than 2° across the entire heating area of the plate and over a period of eight hours. WARS is a hotplate system with a sophisticated closed-loop programmable digital controller, giving the user thermal control precision. The system is suitable for uniform pre-heating of either large or small or panel assemblies for light assembly and rework.

Circle (306) on Fast Fact Card

## Tone & Voice Pager With Monitor Receiver DuraComm®

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Circle (57) on Fast Fact Card

## Rack Mount Power Systems DuraComm®

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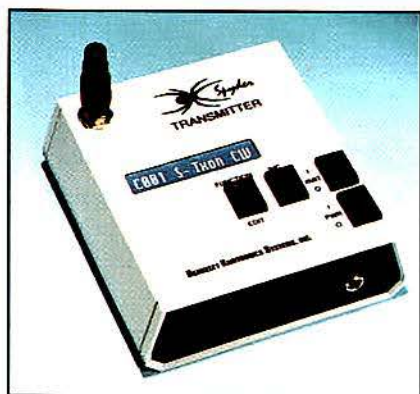
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Circle (58) on Fast Fact Card



## Signal source supports signal analysis meter



The **Spyder** from **Berkeley Varitronics Systems** is a self-contained, frequency-agile signal source for walk-about analysis and propagation studies. It is a companion to the Champ signal analysis meter. The one-pound transmitter can be

mounted magnetically or with Velcro. A 1×16 character LCD indicates channel frequency, modulation mode and transmitted status. The user may select from CS, FM or BER. Option modulation schemes are also available.

Circle (307) on Fast Fact Card

## Digital bearing DF processor features embedded CPU

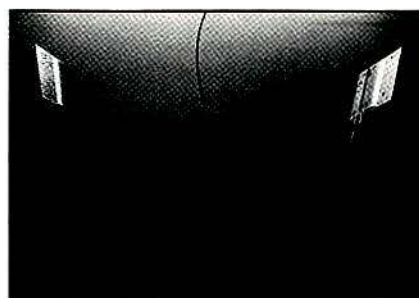
**Cubic Communications'** model 4006R digital bearing DF processor is for vehicle and fixed-site use. The 4006R features an embedded CPU that allows the system to be menu-driven. The system employs a DSP-based bearing processor that provides accurate, repeatable bearings under a variety of conditions and has a remote controllable RS-232 port. The processor interfaces with various OAR antennas to provide DF capability in mobile, fixed base station or ship-board operations. The processor is capable of controlling CDR receivers and other commercial receivers.

Circle (308) on Fast Fact Card



## Cellular, SMR bumper antenna conceals easily

The **MCAS-90STA** bumper antenna from **Hirschmann** consists of two fully encapsulated panels that mount in the side pockets of a car's nonmetallic front or rear bumper. The antenna is a broadband device, operating from 806MHz to 960MHz with a 3dB gain in a nearly omnidirectional pattern around the car. Power input is a maximum of 20W. Features include mounting without visible holes in the car; protection from damage by weather and car washes and no visible masts, which minimizes theft and vandalism.



Circle (309) on Fast Fact Card

## Site monitor, card access, protect tower

**Hark Systems'** TSM 2000 tower site monitor with card access option includes the basic tower site monitoring package that transmits real-time alarms via modem. It includes remote viewing of diagnostics and alarm conditions and a daily record stored at each site of as many as 120 events. The monitoring amperage can detect and report if the bulbs are working properly and if they are out. There are 128 alarms initiated from contact closures for the monitoring of temperature, power outages, building security, transmitter and receiver cabinets, forward and reflected power, voltage and generators. Components can automatically and remotely be turned off and on. The monitor includes as many as 128 analog-to-digital converters and custom internal power supply and battery backup. The card access system allows site owners and managers to control all access to all sites. The expense of rekeying is eliminated. Cards may be immediately and remotely activated and deactivated.

Circle (310) on Fast Fact Card

# poof.

**Preventing downtime due to lightning** is now much easier with the Cutler-Hammer line of Clipper Telecommunication (Tc) Panelboards.

Clipper Tc Panelboards integrate an automatic or manual transfer switch and surge protection filter into a panelboard. Its unique design significantly reduces wall space and installation costs, while providing superior surge protection that has been independently tested. Custom configurations are available to meet your load switching and remote generator monitoring requirements.

Another industry surge protection breakthrough from Cutler-Hammer.



**Cutler-Hammer**

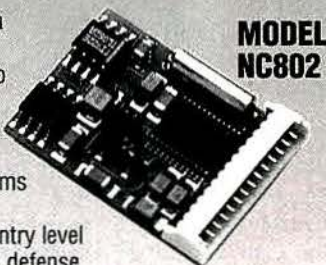
**EATON**

Circle (59) on Fast Fact Card



# VOICE SECURITY ENCRYPTION

The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost effective solution to entry level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.



**MODEL  
NC802**

**For Detailed specifications call our 24 Hour  
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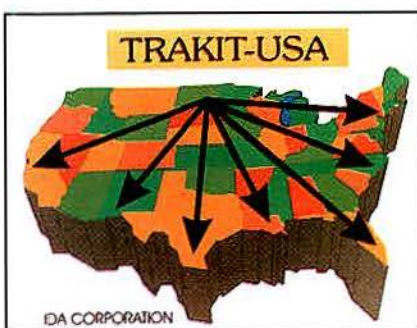
15385 Carrie Dr., Grass Valley, CA 95945

Circle (60) on Fast Fact Card

## New products

### Software offers U.S. map for fleet management

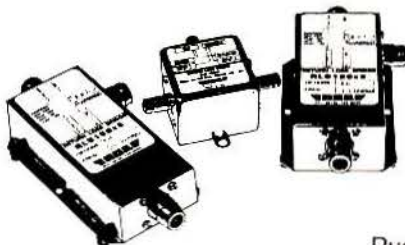
Trakit-USA from IDA is an optional companion product to IDA's Trakit GPS AVL fleet management system. The 32-bit Trakit-USA software module includes a complete digital continental U.S. map on one computer CD.



Dispatchers can instantly zoom between various national scope and city street levels. The complete road and street annotation is zoom-level sensitive. Residence or business addresses can be input and visually pinpointed on demand. Special customer maps can be added as an overlay. The Trakit system with Trakit-USA provides real-time vehicle location monitoring on detail-annotated maps in any service area. Used with the Trakit vehicle data buffer feature, Trakit-USA displays an extended-area, comprehensive historical analysis of fleet activity anywhere in the continental United States. This country-wide AVL digital map option eliminates having to purchase individual local area maps and automatically provides for expansion into new operating areas.

Circle (311) on Fast Fact Card

## VSWR BRIDGES & TEST CABLES



### FEATURES:

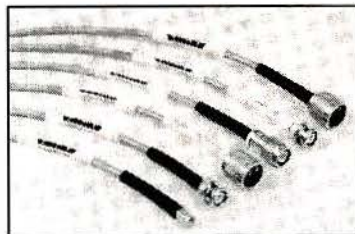
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**Call for FREE application note: "Antenna and Feedline Measurements"**

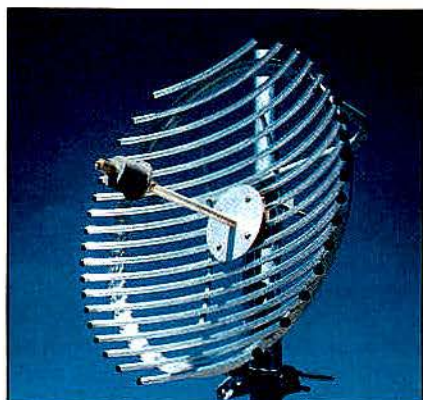
# EAGLE

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Circle (61) on Fast Fact Card



## Microwave antennas include grid, solid parabolic models



Gabriel Electronics' SS series of spread-spectrum microwave antennas includes nine grid and solid parabolic models, ranging from 2"-6" in diameter. Both frequency ranges (2.3GHz-2.5GHz and 5.69GHz-5.925GHz) use feed designs that terminate with type N connectors.

Circle (312) on Fast Fact Card

## AVL closely monitors fleet

Geotek Communications has upgraded its automatic vehicle location (AVL) software. Designed to provide precise, real-time fleet information, AVL PRO enables the dispatcher to record and play back any vehicle's movements during the course of a day to determine the driver's actions, ensuring productivity and increased customer satisfaction. The new capabilities of AVL PRO provide small- to medium-size businesses with greater control of their mobile workforce.

Circle (313) on Fast Fact Card

## Spectrum analyzer identifies signal interference



The AN1800 series spectrum analyzer from IFR Systems is designed for field testing, manufacturing or lab use. It offers three color LCD models: AN1820 (9kHz-2.9kHz), AN1830 (9kHz-22GHz) and AN1840 (9kHz-26.5GHz). Incorporating

the widest FM demodulator available, the AN1800 instantly displays frequency hopping signals. The unit's wide dynamic range, frequency counter and built-in AM and FM receiver are for identifying signal interference. With its digital storage scope and FFT, audio and baseband measurements can be made with one instrument. The AN1800 allows off-the-air wireless performance testing without the use of external amplifiers or special filters. A 3Hz-resolution bandwidth filter enables close-in signal analysis. The marker search function and optimized displayed noise level simplifies the location of low level spurious and harmonic signals.

Circle (314) on Fast Fact Card



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Circle (62) on Fast Fact Card

# sizzle.

... The sound of a rectifier failing due to a power surge. Protect your critical telecommunication equipment with Cutler-Hammer's AEGIS+.

AEGIS+ is a "two stage" hybrid series AC suppressor, designed by Cutler-Hammer exclusively for rectifier protection. Its small footprint and dependable, maintenance-free suppression are ideal for remote PCS or cellular sites that need to reduce high energy lightning surges to harmless levels.

When performance, reliability and space limitations matter, Cutler-Hammer surge protection is the answer.



**Cutler-Hammer**

**EATON**

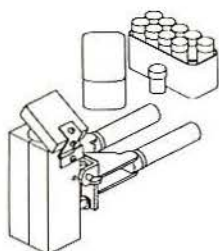
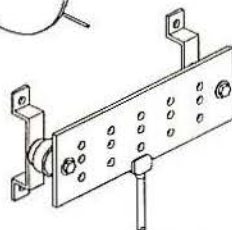
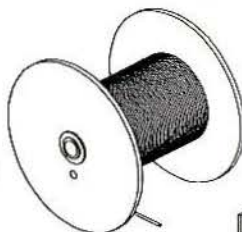
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## New products

### Portable radio serves families; no license required

The Freetalk from **Kenwood Communications** is a lightweight portable radio for personal use on the Family Radio Service bands. Fourteen channels and 38 talk groups with Privacytalk (scrambling), group mode (CTCSS) and auto channel select are among the high-test features. Weighing 6.3 ounces with a flip-down antenna, swivel belt clip and LCD channel display, the radio is for use during outdoor sports or just to keep track of family members at the stadium or mall. The FCC authorized the UHF Family Radio Service to operate in 14 channels in the 460MHz frequencies. Powered by three AA alkaline batteries, Freetalk has a two-mile range and can be kept on standby for 120 hours.

Circle (315) on Fast Fact Card



### Surge protector fits into PCS minicell base stations

Cutler-Hammer's Aegis+ is lightning protection for PCS minicell base stations. Installed after the main disconnect breaker, Aegis+ fits into PCS minicells easily because of its small size. The protector has a two-stage design that uses filter components that are tuned to the dominant frequencies for surges and electrical line noise. Series elements in the Aegis+ slow down the surge to enable the two suppression stages to work independently and to minimize the let-through voltage.

Circle (316) on Fast Fact Card

**NEW!**

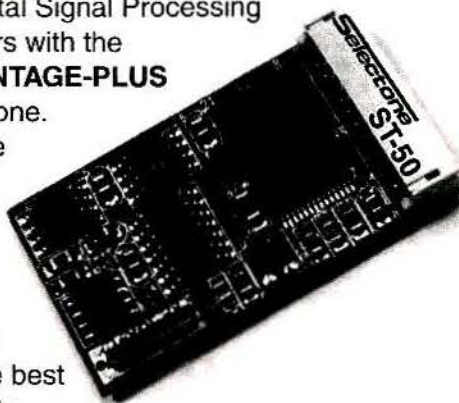
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Circle (65) on Fast Fact Card



## Amplifier provides power from lowband to 960MHz

TPL Communications' HMS power amplifier series provides high-power output from lowband through 960MHz. It is manufactured for rugged use while combining technology into a space-efficient package. The units in this series are self-contained with a regulated switching power supply, using only 10 1/2" of vertical rack space and 15" of depth. The units are self-monitoring, using a newly added digital meter, which provides a readout of the amplifier's test conditions. This series has been mechanically redesigned to make the unit more functional. Input and output connectors have been moved to the rear of the unit, making it easier to connect coaxial cables. The amplifier deck has all wiring contained in one cable, which can be disconnected, allowing only the electronics to be removed for servicing.

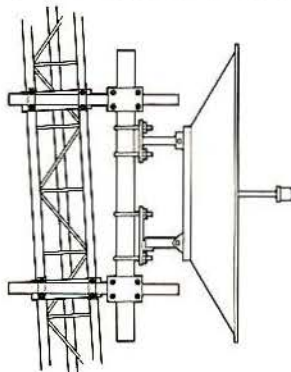
Circle (317) on Fast Fact Card

## UHF jack series expands to 2-, 4-hole panel mounts

RF Connectors has expanded its UHF jack series of connectors and adapters. These connectors are available with silver- or nickel-plated bodies, silver- or gold-plated contacts and Teflon or high-temp phenolic insulation. All UHF female interfaces feature 16 v-grooves for mating with UHF male body chucks. Configurations now include two- and four-hole flange panel mounts, both rear-mount and front-mount bulkhead or chassis mounts and a variety of crimp or clamp models for cable terminations.

Circle (318) on Fast Fact Card

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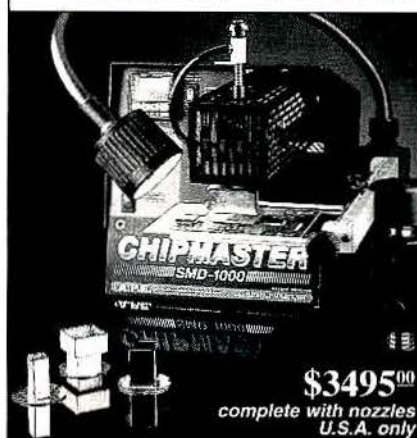


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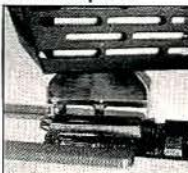


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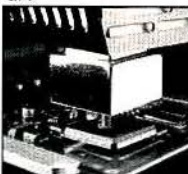
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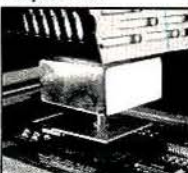
QFP



RF Shield



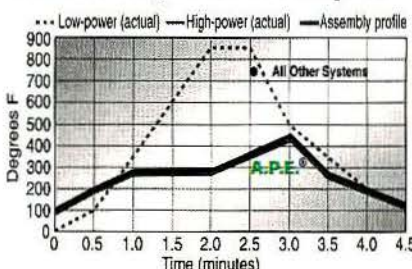
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Circle (40) on Fast Fact Card



## New products

### Dispatch module gives users single point of access

ServiceWare's Series 3 dispatch module is a 32-bit, Windows NT and 95-based service information system (SIS), employing ODBC, OLE and client-server technologies. Dispatch's call management, assignment, scheduling, dispatching and escalation functions have been fully integrated with the existing suite of Series 3 modules (logbook, inventory, purchasing, logistics, contracts). Series 3's architecture

provides dispatch users with a single point of access to the entire Serviceplus system, equipment, customer and contract notices, extensive "drill-down" capabilities and on-line resolution statistics. Dispatch supports an unlimited number of assignments per call, tracking and escalating each site visit as a distinct entity while monitoring overall response on the call.

Circle (319) on Fast Fact Card

### Lightweight headsets offer discrete two-way comm

Otto Communications' headsets allow for high-clarity, discrete two-way radio communications while providing additional comfort for extended wear. The lightweight headsets are compatible with a variety of radio makes and models, and component parts for custom applications are also available. The headsets feature a flexible, electret boom mic with replaceable windscreen and comfortable, adjustable foam cushion headband. They have a fully rotating boom mic for left or right side positioning, replaceable foam ear cushions and single or dual speaker versions.

Circle (320) on Fast Fact Card

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## Distribution

Connect Systems has announced exclusive distribution for Canada. CSI tone panels, interconnects, LTR controllers and communications decoders will be marketed in Canada by **Cartel Communications Systems**. Cartel has offices and distribution centers in British Columbia, Alberta and Ontario.

For more information, call 604-888-9711.

**Hutton Communications** has been appointed a distributor of power systems products from the Microelectronics Group of Lucent Technologies. Hutton will distribute dc power plants, power supplies, storage batteries and related products.

For more information, call 972-239-0580.

Dataradio has introduced its new distributor in Western Canada, **Encom Radio Services**. Encom will distribute the connectivity over radio (COR) line of products. Comprised of products for fixed applications, the COR line is primarily used in the industrial arena, such as oil and gas, mining and alternative energy processing.

For more information, call 770-392-0002.

**Fourth Dimension Industry** has recently become one of Motorola's authorized paging distributors in the United States. Fourth Dimension will supply a wide variety of products and services including, the maintenance and management of pagers' inventory, order handling and processing, customer service and support and product promotional material.

For more information, call 1-800-378-0348.



Circle (54) on Fast Fact Card



## EMC encyclopedia includes 3,000 entries, updated annually

**EMF-EMI Control's** 1997 *EMC Desk Reference Encyclopedia* is a compendium of 3,000 EMC-related entries. The 384-page desk-reference compilation is for professionals worldwide who need to know about electromagnetic compatibility. The encyclopedia addresses subjects of units, terms, definitions, formulas, math models, tutorials, case histories, problem solutions, regulations, standards, test methods and procedures, acronyms, products, services, government agencies, organizational bodies and almanac topics. Starting in 1998, each annual edition will be completely updated and expanded.

Circle (351) on Fast Fact Card

## Global digest, divided into regional editions, covers 55 countries

**IMTA's** *Global Digest for Commercial Trunked Radio Systems* is now available in four regional reports: North and South America and the Caribbean; Europe and Eurasia; Asia Pacific; and Middle East and Africa. The study was divided into regional reports to make the information more accessible to those who only are interested in one area of the world. Until now, the digest had to be purchased in its entirety. To date, the reports cover more than 55 countries that have a commercial trunked radio industry. Each country chapter includes country background information, analysis of the regulations governing the industry and market statistics based on industry surveys distributed to operators worldwide. Each country chapter includes more than 20 pages of information.

Circle (352) on Fast Fact Card

## Catalog contains cellular products

**Antenna Specialists'** new catalog includes information on the line of fixed-station yagi antennas to accommodate CDPD applications. The catalog includes reference charts, product benefits and technical tips for connector selection. The catalog also features the patented On-Glass series.

Circle (353) on Fast Fact Card

## Catalog offers telemetry products

**RF Neulink's** telemetry catalog features crystal-controlled and synthesized wireless transceivers, paging transmitters and excitors, transmitters and receivers. Also featured are the Skyline remote data acquisition and control systems with digital and analog I/O in both UHF and VHF versions. These transceivers with intelligent modem and operational software are enclosed in a 3"×3"×2.5" stainless-steel enclosure.

Circle (354) on Fast Fact Card

## Study analyzes U.S. mobile data marketplace, forecasts revenue

**The Strategis Group's** *The U.S. Mobile Data Marketplace: 1997* is an analysis of the mobile data marketplace. This study includes an in-depth analysis of messaging and mobile data services for the following applications: cellular, PCS, paging and narrowband PCS, SMR and private radio, satellite, wireless Internet and dedicated mobile data. It also features subscriber and revenue forecasts,

wireless location market potential, a profile of mobile data carriers and services across industries, analysis of the telemetry market potential and analysis of five vertical markets (utilities, petroleum, trucking, public safety, insurance). The study has subscriber, equipment and services revenue projections to the year 2002.

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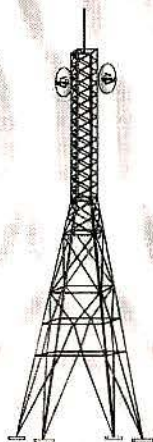
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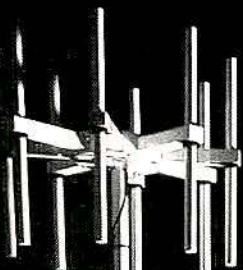
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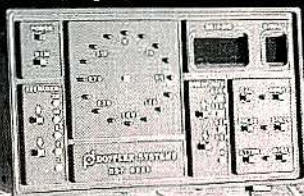
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## P eople



Lyon



Mallonee



Jones



Thompson

Promotions at the American Mobile Telecommunications Association:

**Jill M. Lyon** advances from director for regulatory relations to vice president.

**Lynne D. Mallonee** moves up from director to vice president of communications and association services.

**James Jones** leaves PRTM, an operations management consulting firm in Mountain View, CA, to join Litton Solid State, Santa Clara, CA, as vice president.

**Kasey O. Thompson**, who previously owned his own construction firm, joins Western Communications, Boise, ID, as sales representative.

**Jerry Miller** departs Pro-Gard Industries, Indianapolis, as president to join Gamber-Johnson, Stevens Point, WI, as general manager.

**Judith Areen**, the executive vice president for law affairs of Georgetown University and dean of the Law Center, is elected to the board of directors at Geotek Communications, Montvale, NJ.

**Yves Guyomar** leaves Philips' technical and industrial center in Brive, France, as manager to join Boonton Electronics, Parsippany, NJ, as president.

**Glenn Ehley**, director of PCS for AirNet Communications, Melbourne, FL, advances to vice president of sales and marketing.

Changes at Comserv, Memphis, TN:

The board approves a plan to establish three separate companies: Comserv Consulting, Comserv Telecommunications Services and Comserv, the existing two-way radio and paging business.

**Mark S. Allen** departs E.F. Johnson, Burnsville, MN, as vice president of engineering to join Comserv as corporate vice president.

**James G. Crinklaw**, corporate vice president, is named division president, responsible for Comserv Consulting.

**Amy Tesch** leaves College Media, Great Neck, NY, as director of sales and marketing to join E Comm International, Tucson, AZ, as marketing assistant.

Changes at Wavetek, Indianapolis:

**Eric A. Meger** departs Glenayre Electronics, Charlotte, NC, as director of satellite systems and corporate development to join Wavetek as wireless business unit manager.

**Cyrille Damany** leaves Motorola's European Paging Subscriber Division in Germany to join Wavetek as general manager of the Wireless Communications Division, Ismaning, Germany.





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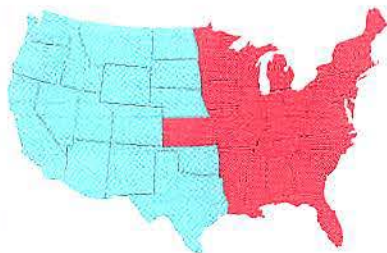
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### 17. Signature and Title of Editor, Publisher, Business Manager, or Owner

**Don Bishop, editorial director** Date **Sept. 25, 1997**

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Although the explanations of the latest developments make good articles, so do tutorials that explain basic subjects. Reviews of digital signal processing, microwave system design and software have proven popular, for example. "How-to" descriptions are well received.

### Editorial assistance

Some articles arrive ready to be published. If an article is not quite ready for publication, our editors can make the necessary modifications, sometimes requiring only a telephone conversation with the author. If for some reason an article must be returned, suggestions are included for revisions that would make it ready to publish. A set of guidelines for writing is available for the asking.

Artists are available to prepare artwork, such as drawings and graphs. Sketches submitted can be redrawn for illustrations. Camera-ready artwork is welcome, also.

Color photos are considered for use on the cover; slides and transparencies work best as cover illustrations. Otherwise, photos may be submitted as slides, transparencies or prints. If you would like to submit a picture as a possible cover illustration, we recommend you talk with an editor to increase your chances of obtaining a usable photo on the first try.

We have editors who love to help people prepare articles for the magazine. If you are undecided whether your topic might be suitable or if you need help at any stage in the writing process, please call. We would love to hear from you.

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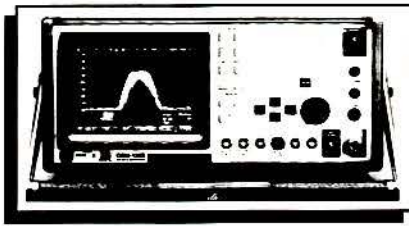
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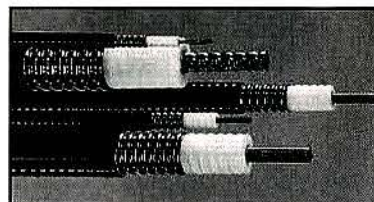
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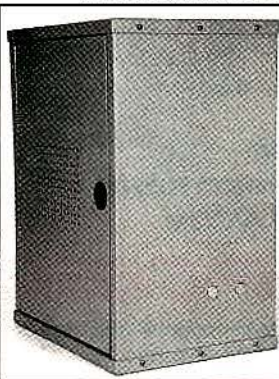
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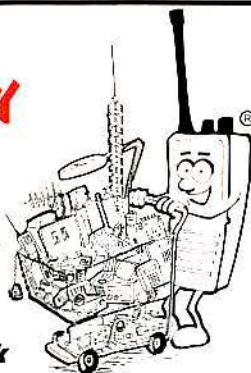
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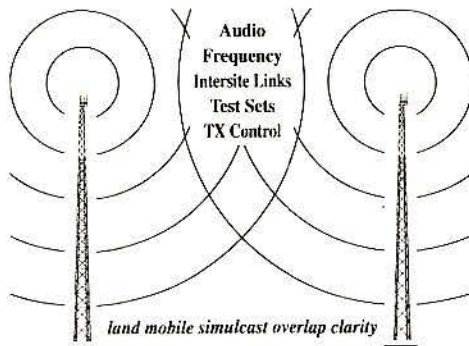
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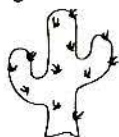
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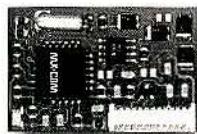
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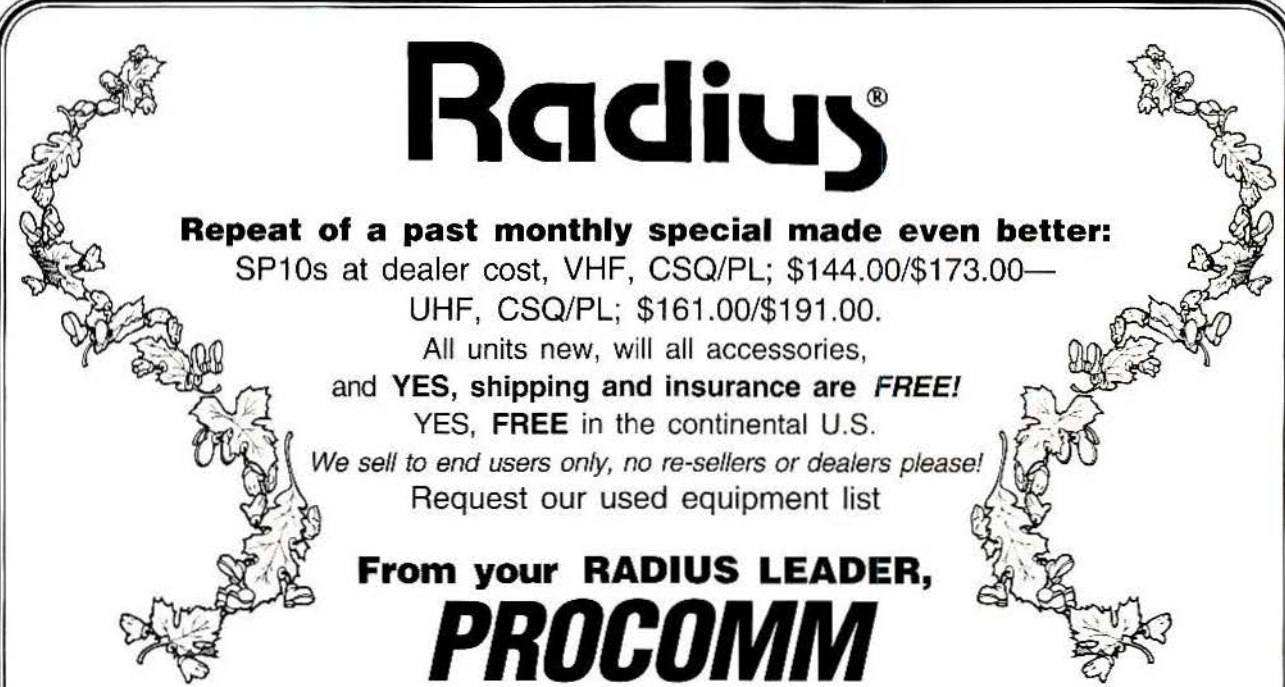
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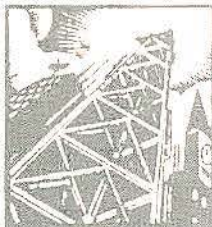


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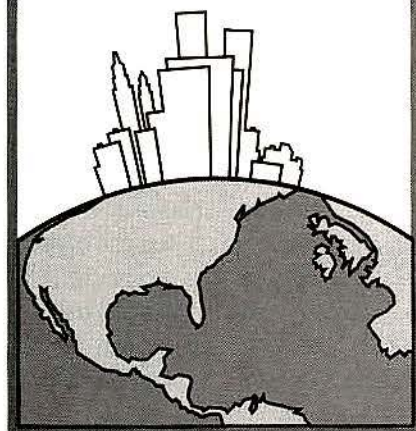
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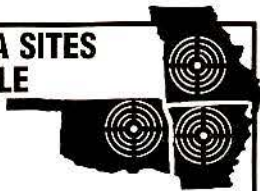
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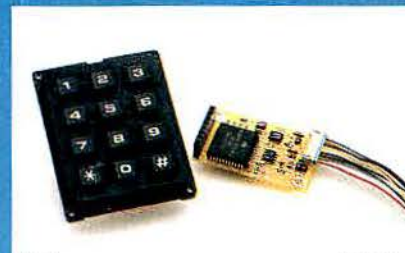
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